September 1945

Urbana, Illinois

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of the

ILLINOIS NATURAL HISTORY SURVEY

THEODORE H. FRISON, *Chief*

Contents and Index

Volume 22

1941–1943

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STATE OF ILLINOIS

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(81447—800—4-45)

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EMENDATION

Page 61, second couplet under *Fulvius* Stål, Key to Species.
Read as follows: Second antennal segment brown, apical third or fourth white at apex; scutellum uniformly brown .... **imbecilis**, p. 61

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Volume 22 | BULLETIN | Article 1

The Plant Bugs, or Miridae, of Illinois

HARRY H. KNIGHT

Printed by Authority of the State of Illinois

URBANA, ILLINOIS

September 1941

This paper is a contribution from the Section of Insect Survey.

(A47723—2,200—5-41)

FOREWORD

THE Miridae, or plant bugs, containing well over a third of the species of the order Hemiptera, have long attracted attention because of their abundance, their diversity of shape and the great variety of plant hosts they attack. Except for a few predacious species, they suck the juices from plant leaves and, with the leafhoppers, aphids and scale insects, rank as one of the most important groups of plant sucking insects in Illinois.

Early in 1930, a project to investigate the Miridae of Illinois and to prepare a comprehensive report on the state fauna was organized. Dr. Harry H. Knight, Iowa State College, Ames, Iowa, was enlisted as leader of the project to direct the initial intensive collecting for the group, identify the material and write the final report, and he was employed by the Survey as Assistant Entomologist during the summers of 1930, 1932, 1933 and 1937 to acomplish these objectives.

Intensive collecting was begun in 1930. Prior to this date much material had been assembled by earlier Illinois collectors, particularly C. A. Hart and C. W. Stromberg, whose specimens in the Natural History Survey collection formed not only a good general collection of the group but also included several species not taken in our recent search. Much interesting material collected in Illinois by W. J. Gerhard was lent us by the Field Museum of Natural History, Chicago.

Field work for this group followed very closely the pattern developed during an earlier study of Illinois aphids (Hottes & Frison 1931). Collecting was done in every part of the state, from south to north, east to west, and repeated at different seasons in an attempt to capture species which might be restricted to certain periods of the year or to limited local habitats. Using known mirid host plants as a guide, we attempted to collect from every species of probable host in every locality visited.

This procedure was followed in 1930 and 1932. In 1931, drought conditions reduced the mirid population to a low ebb, making collecting for this group impractical. In 1934, 1935 and 1936, intensive collecting for leafhoppers turned up many more Miridae, including a large number of new records for Illinois. A total of about 20,000 specimens was accumulated, including the 5,000 specimens already in the collection before our drive for this group began. All members of the Insect Survey Section staff have at various times aided with the field work and preparation of material for identification and preservation.

Much of the work of final identification of material and completion of the manuscript was done by Dr. Knight at Ames, Iowa, while not attached to the Survey, and I wish to express our gratitude to him for spending so much of his own time in bringing this project to a successful conclusion.

Several members of our staff in the Insect Survey Section also have contributed greatly to the final manuscript. The many full illustrations of Miridae are with few exceptions the work of Dr. C. O. Mohr, Associate Entomologist and Artist. Dr. Mohr and Miss Kathryn M. Sommerman, Entomological Assistant, also added many illustrations used to illustrate key characters and male genitalia. Summarizing the Illinois collection data and adding it to the manuscript, modification of the keys to emphasize as much as possible characters which could be illustrated, and adapting the manuscript to current Survey practices represent the painstaking and effectual work of Dr. H. H. Ross, Systematic Entomologist, and Dr. B. D. Burks, Assistant Entomologist. The section on economic status and control is in part the work of Prof. W. P. Flint, Chief Entomologist. Finally the manuscript was read and styling determined by the Editor, Mr. James S. Ayars.

T. H. Frison, *Chief*
Illinois Natural History Survey

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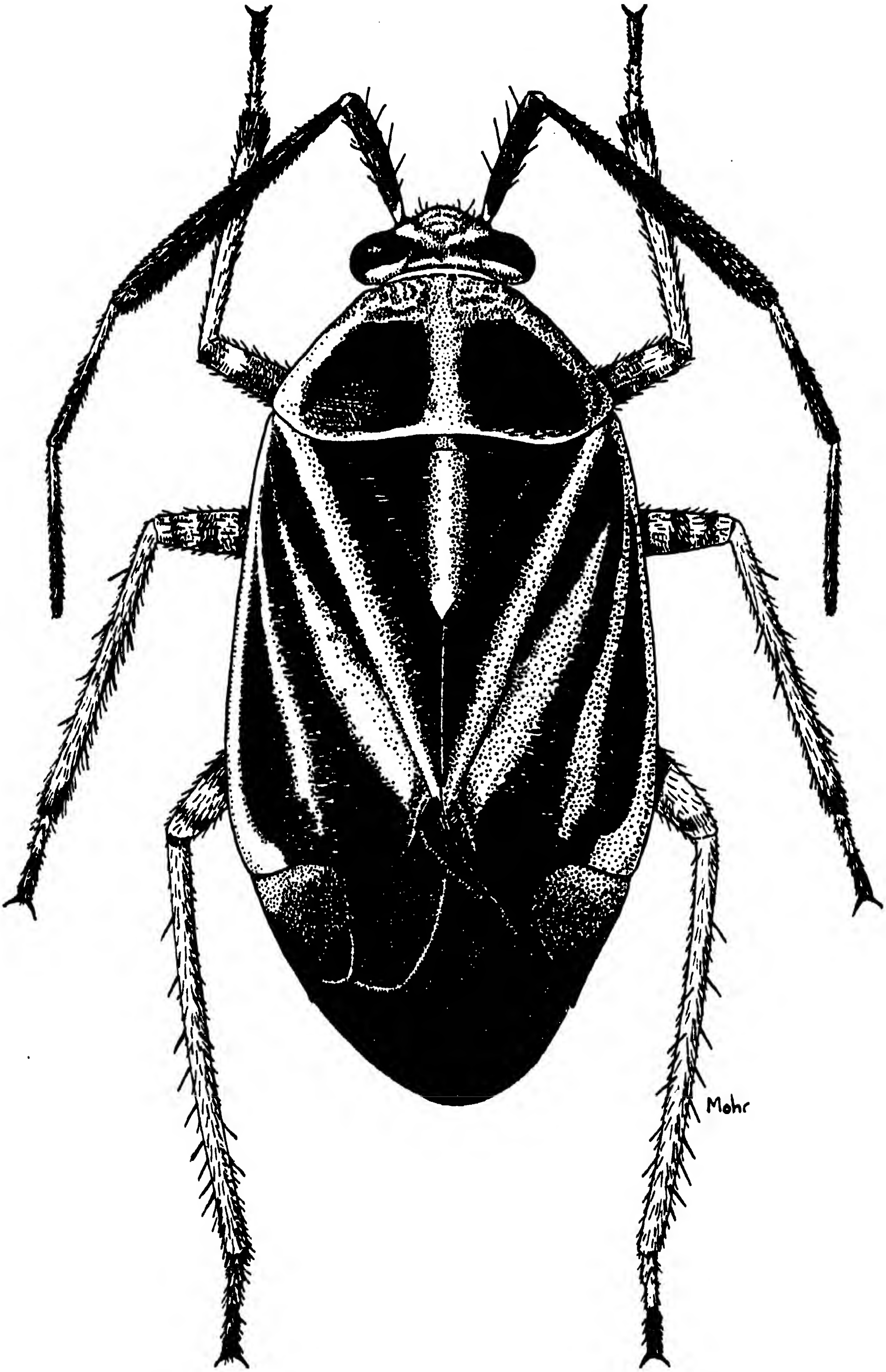


Horcias illini.

Typical in general outline of many plant bugs found in Illinois, but among the more striking in coloration and markings.

The Plant Bugs, or Miridae, of Illinois

HARRY H. KNIGHT*

Introduction

THE list of Miridae of Illinois now stands at 330 species. It is apparent, however, that species known from neighboring states will eventually be found in Illinois. Furthermore, in the study of Illinois species, it was found that many records of these species were a great distance from any other previously known records. Hence, it was thought advisable to include in the keys other species and varieties known from the entire general region in which Illinois is situated. One hundred ten extralimital species were, therefore, included, bringing the total number treated in this report to 440 species. It seems highly probable that from two-thirds to three-fourths of these extralimital species will eventually be found in this state, which would bring the list of Illinois Miridae to about 400 species.

In the list of insects for New York (Leonard 1928),† I recorded 296 species of Miridae, but since publication of this list additional records have raised the total to 316. A list of Miridae for the District of Columbia and vicinity (Knight & McAtee 1929) records 200 species of Miridae within a 25-mile radius of Washington, D. C. The state of Illinois, which includes within its borders the cypress swamps about Cairo and the northern tamarack bogs bordering Wisconsin, represents an ecological range scarcely exceeded by any other state east of the Mississippi River. This range undoubtedly accounts for the large list of Miridae.

In number of species, the Miridae far exceed other families of Hemiptera. In the Palearctic region, where the total number of Hemiptera is best known, the "Oshanin Katalog" (Oshanin 1910) enumerates 1,078 species for the family Miridae and but 2,486 species for all other families of Hemiptera combined. In North America, north of Mexico, approximately 1,500 species of Miridae are known; of other families of Hemiptera, about 2,500 species.

Because of the fragile nature of the pubescence and appendages of the mirids, special attention had to be given to their collection. The collecting party, consisting of two or three members, equipped with nets, bottles, pinning and mounting accessories, and desk lamps, was usually in the field for periods of 10 days to 2 weeks. Each day, collecting was discontinued at about 4 P.M., and headquarters were set up for work in a hotel room where the day's catch was pinned to prevent unmounted insects from being battered in transit.

The collecting party used sweeping nets, each having a ring 15 inches in diameter and a bag of bolter's silk. These were found ideal for mirids, since they excluded so little light from the bottom part of the net that the mirids did not swarm too rapidly to the top. Test-tube cyanide bottles about 6 inches long were used, with the cyanide in the bottom; the diameter of the tube was as large as could be stoppered by the operator's thumb. In each tube were a few loose strands of cellucotton. The bugs were "picked" off the sides of the nets into the bottle, which could be conveniently stoppered by the thumb until emptied.

With this group, care must be taken to have only a small number of individuals in each bottle at one time; otherwise considerable pubescense is rubbed off. After the specimens are dead, they may be transferred to pill boxes or other temporary containers. If mirids are left in the cyanide bottle too long, some of the yellow and orange colors change to deeper tones, sometimes to red.

*Iowa State College, Ames, Iowa; Assistant Entomologist, Illinois Natural History Survey, during summers of 1930, 1932, 1933, 1937.

†Miridae, Isometopidae (Knight 1923b), pp. 110 35.

As mirids are much easier to handle before they have dried out than after, each day's catch was pinned up the following night to insure the best possible specimens. All mirids were mounted on card points with a crimp and in such a way that the crimp was glued to the side of the mesothorax and not to the legs only. The mounted specimens were then pinned in Schmidt boxes for traveling and taken back to the laboratory at Urbana, where they were labeled and later identified.

Biology

The eggs of most mirids hatch early in the season when the host plants are making tender new growth. It is worthy of note that in the case of species known to produce a second generation the host plant is one which produces succulent growth during the summer season. Thus, the tiny young nymphs find the maximum amount of sap for food which is essential for plant feeders. Mirid eggs, fig. 1*A*, are elongate, slightly curved or bean shaped, with a cap and micropyle on the end pointing to the outside of the plant substance where embedded.

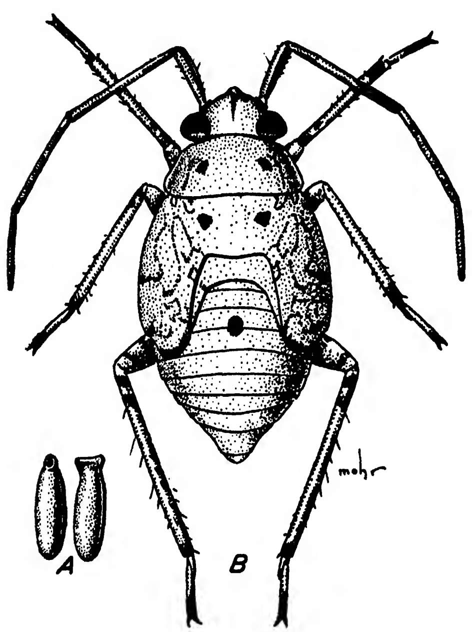


Fig. 1.—*Lygus oblineatus*; *A*, egg, front and lateral view; *B*, fifth instar nymph.

Life Cycle

Mirid nymphs pass through five instars or stages of development and at the fifth molt attain sexual maturity and, except in special cases where the adults are wingless, a set of wings. The time required for nymphal development varies with different species, but many of them are known to require 20 to 30 days. Beginning with the third nymphal instar the development of wing pads may be observed. During the fourth instar the wing pads are clearly evident, while in the fifth instar, fig. 1*B*, the wing pads usually extend back to the middle of the abdomen. Many mirid species have been observed to possess during nymphal development the curious habit or ability of protruding a posterior portion of the rectum; when a nymph is dislodged and falls from a branch or leaf to the foliage below, the rectum is protruded, and, being provided with sticky material, acts as an adhesion disk upon striking foliage of the limbs below. The nymph then scrambles for a foothold, pulls the adhesion disk free, retracts the rectum and runs for cover among the leaves. Thus the eversible rectal disk saves many falling nymphs from losing contact with the host plant.

The adult females may mate within 2 or 3 days after emergence but do not start laying eggs until a week or 10 days later. The males are generally the first to mature, but they do not live so long as the females.

I have described (1915) in detail the oviposition work of four mirid species but here recount only selected parts. Observations on *Heterocordylus malinus* Reuter were made on crabapple and cultivated apple in western New York. Females that matured June 12 were observed to oviposit on June 21. On the morning of June 23, four different females were observed while ovipositing.

When a female is ready to oviposit she moves up and down the branch, patting the surface with antennae and touching the bark here and there with the tip of the proboscis. In this manner one spent 6 minutes searching for a place to oviposit. Another individual required 15 minutes before she found a suitable place. The female begins to drill the hole by means of the proboscis, and this operation may require from 5 to 18 minutes before the hole is ready for the insertion of

the ovipositor. After drilling the hole with the beak, the female arches the abdomen, stands as high as possible, then unsheaths the ovipositor and thrusts it forward to locate the place prepared. She turns her head under with the tip of the proboscis in the hole to help guide the ovipositor. One female was observed to make seven attempts before inserting the ovipositor. Most individuals make two or three attempts before succeeding. After each failure, the female inspects the hole and works upon it for a time with her beak. Once insertion of the ovipositor is started, the female works the abdomen up and down with a rapid, jerky motion until the ovipositor is inserted to its base. An alternate contraction and expansion of the abdomen then occurs while the egg is being worked down into position. This operation requires about 2 or 3 minutes. The female then withdraws the ovipositor and rests for 3 to 5 minutes before inserting the second egg. After this interval, she again locates the hole by means of antennae and beak and then repeats the operation of inserting the ovipositor. In some cases only one egg is laid in a place, but two eggs appear to be the normal number for this species.

The number of eggs laid varies with the individual from day to day. One female was observed to oviposit in six different places between 10:00 A.M. and 12:00 o'clock noon. This same female was observed to oviposit daily from June 23 to 27, but died on June 28.

The apple redbug, *Lygidea mendax* Reuter, breeds on hawthorn and apple; it matures a week to 10 days later than *Heterocordylus malinus*. In 1914, at Batavia, New York, the majority of females matured about June 20. Several females were watched closely but no eggs were obtained until July 8. When ready to lay, the female moves about over the twigs, searching for lenticels on wood of the previous year's growth. She drills the lenticel by means of the proboscis. One female required 10 minutes for this operation. She failed in three attempts to insert the ovipositor but on the fourth she succeeded. She took 2½ minutes to lay the egg. After an interval of 4 minutes, she returned to the hole and upon the second trial inserted the ovipositor and laid an egg. She then sealed the wound by means of the proboscis. The lenticels are normally light colored but, after being injured by the process of oviposition, they appear reddish brown. The eggs are placed in the cambium at such an angle that the lower ends rest on solid wood and their tips are 1.5 mm. apart. Females of this species were observed ovipositing on trees in an orchard as late as July 18.

The pear plant bug, *Neolygus communis* Knight, oviposits in the cambium of pear twigs. The actions of the female are very similar to those of the species described

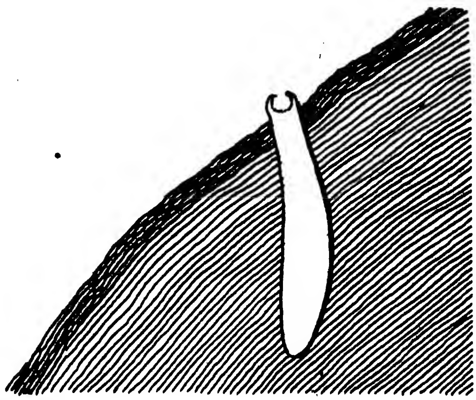


Fig. 2.—Egg of *Paracalocoris colon*, shown in cross section of new growth of apple bark. Adapted from Knight (1915).

above. Examination of one oviposition point revealed that six eggs had been laid in a space 1.0 mm. long. The eggs were closely packed in a double row lying flat just within the cambium layer. Eggs measured were 1.05 mm. in length by 0.26 mm. wide.

An apple mirid, *Paracalocoris pallidulus* McAtee, was found to lay eggs only where dead wood was available. Females that were caged on limbs free from scars and dead stubs did not oviposit. Four females were observed to lay when placed on branches having dead stubs. Five eggs were placed around the margin of one stub, a new hole being made for each egg. The egg of this mirid differs from those of several species at least in having a white cap with two keels that curve up and nearly meet over the top of the egg, fig. 2. The egg cap projects from the cavity as shown in the figure but is not conspicuous because of the uneven character of the rough bark and surrounding wood. Eggs laid in July remain until the following spring before hatching.

A majority of mirid species produce only one generation per year, but a few have been

found to produce two or more generations in one season.

Lygus oblineatus (Say) may produce two or three generations in one season; *Halticus bracteatus* (Say) breeds continuously during the warm season and is credited with five generations in South Carolina. *Adelphocoris lineolatus* (Goeze) rears two generations in a season on alfalfa and sweet clover. *Neoborus amoenus* (Reuter) rears two generations in one summer on white ash. The cotton flea hopper, *Psallus seriatus* (Reuter), breeds continuously as long as the succulent host plants remain green.

Hibernation

A majority of mirid species pass the winter in the egg stage. Usually the eggs are embedded in some part of the host plant. In the hop mirid, *Paracalocoris hawleyi* Knight, the female bugs embed their eggs in the poles used for support of the host vines. The writer observed several females of *Neolygus johnsoni* Knight laying eggs in the soft, punky stubs formed by the breaking off of old dead limbs on the host tree, hornbeam (*Carpinus caroliniana*). Many species, such as *Lopidea davisi* Knight, *Labopidea allii* Knight and *Adelphocoris lineolatus*, lay eggs in stems or leaves of herbaceous plants and pass the winter in the dry stems. The apple redbug, *Lygidea mendax, Heterocordylus malinus* and *Neolygus communis* place eggs in the living cambium on branches of the host tree where they pass the winter.

Mirid eggs, fig. 2, have a relatively impervious chorion which permits them to remain viable for several months, although embedded in material which is almost completely desiccated.

Relatively few species hibernate as adults. *Stenodema vicinum* (Provancher) and *S. trispinosum* Reuter are known to do so and no doubt other members of the genus do likewise. Adults of *Lygus oblineatus, L. vanduzeei* Knight, *L. plagiatus* Uhler, *L. pabulinus* (Linnaeus), *L. campestris* (Linnaeus) and *L. rubicundus* (Fallen) have all been taken in hibernation, and it seems a characteristic of the genus to overwinter in the adult stage. Species of the subgenus *Camptobrochis* of *Deraeocoris* hibernate as adults, so far as known, with *D. nebulosus* (Uhler), *D. poecilus* McAtee, *D. histrio* (Reuter), *D. nubilus* Knight frequently taken in winter. Here again hibernation appears to be a group characteristic. *Dicyphus vestitus* Uhler and *D. discrepans* Knight also have been taken in hibernation.

Feeding Habits

Probably a majority of the species of Miridae are plant feeders, but a large number are now known to be chiefly predacious. The predacious habit is only partially developed in certain species and thus insect blood serves merely to supplement the sap obtained from particular food plants. In the genus *Deraeocoris* the different species appear to be chiefly predacious; *D. aphidiphagus* Knight feeds on the elm aphid, *Eriosoma americanum* Riley, and its honeydew; *D. nitenatus* Knight feeds on the woolly apple aphid, *Eriosoma lanigerum* (Hausmann); *D. pinicola* Knight feeds on *Chermes pinicorticis* (Fitch). It seems highly probable that most members of the subfamily Cylapinae are predacious or mycetophagous; namely, species of *Fulvius* and *Peritropis* and *Cylapus tenuicornis* Say; known species of these genera are normally found about dead trees, hiding in crevices of the bark on logs and stumps. In the large genus *Phytocoris*, several species are known to be predacious, particularly the dark-colored, bark-inhabiting ones. Fulton (1918, pp. 93-6) demonstrated that *Pilophorus perplexus* Douglas & Scott feeds freely on apple aphids, three nymphs having reduced a colony of 50 aphids to 6 within 2 days.

Among the plant feeders, probably the greater number of species are limited to a single host, or to a genus of plants, while a very few, such as *Lygus oblineatus* and *Halticus bracteatus* have a wide range of food plants. Even among species which always breed on a single host plant, a general dispersal of individuals usually takes place. Following the time of emergence and mating, individuals of *Tropidosteptes cardinalis* Uhler, *Lopidea staphyleae* Knight and others have been observed to migrate from their host plant to shrubbery in the general vicinity; thence they doubtless become dispersed over wider territory and to new plants, although, in the normal course of their life, they eventually return to suitable growth of the preferred host plant for the purpose of oviposition.

Since a majority of species of Miridae are definitely limited to a single species of plants or at least a genus of plants, we may expect

the distribution of the bugs to be limited to areas where the host species grow. No doubt in times of migration and when buffeted by strong winds, many individual bugs may be carried far from their normal host and hence perish without successful reproduction. It appears that several species of Miridae are so restricted by ecological factors that their distribution is more limited than the host upon which they live. This is certainly true of the apple redbug, *Lygidea mendax*, which normally breeds on species of *Crataegus*; but the *Crataegus* grows far south and west of the areas where *L. mendax* can be found.

While making a close study of *Lygidea mendax* the author noted that the bugs were never found on isolated trees exposed on high ground where the sun was hot and the atmosphere very dry. The bugs seemed to thrive only in valley areas where the humidity rarely dropped to desiccating levels. The nymph of *L. mendax* is very delicate, the body wall evidently only thinly chitinized; so it can live only where the humidity is high enough to prevent desiccation. The writer believes that the southward distribution of this species is limited chiefly by the high temperatures and desiccating atmosphere frequently encountered west of the Mississippi and south of the Ohio rivers. It seems likely that other Miridae of the Boreal region may have their southern distribution limited for the same reasons.

In contrast to the above, we may take another species, *Heterocordylus malinus*, of which the favorite wild host is *Crataegus*. This insect is more widely distributed than *Lygidea mendax*, for it is frequently found on *Crataegus* in Texas and Mississippi, apparently able to live wherever the host plants thrive. If we examine nymphs of *H. malinus* we find the body wall is more heavily chitinized than in *L. mendax*. The nymphs are not subject to fatal desiccation when the leaves of the host plant wilt under the heat of a hot, dry day. Some years ago the writer reared in breeding cages many nymphs of both species, and at that time first observed the more delicate nature of *L. mendax*. When both species are kept in cages on host plant foliage, and the host leaves are allowed to dry out, *L. mendax* will die immediately whereas *H. malinus* will live for several hours.

Distribution and Habitat Preference*

In Illinois the distribution patterns of the Miridae are linked primarily with those of their plant host species. Other factors also play a very important part in determining mirid distribution patterns, but the influence of these is not always obvious from a study of such a limited area as one state. The greater part of the uncultivated areas of Illinois is covered with either oak-hickory forests or prairie and the various types of community which lead up to them. There are certain restricted areas, however, in which we find mirid hosts found nowhere else in Illinois. These are the result of the rather axial geographic position of Illinois. This state is a long, narrow area, the northern end just bordering some of the coniferous communities which are common in Wisconsin and its southern end extending slightly into conditions typical of the southern states. In respect to east and west, Illinois is the mingling ground of the eastern deciduous forests and the western grasslands, with here and there an invasion of typical western plants in some of the sand areas. Small areas of peculiar interest are marked on the accompanying maps.

Mirids in Restricted Areas

The tamarack bogs, fig. 3*E*, are remnants of the glacial bogs. In Illinois they are restricted to the small area in the vicinity of Volo and Antioch in the extreme northeastern portion of the state. They have been encroached upon by agriculture to a considerable extent, but a few remain which have preserved their flora and fauna practically intact. These bogs, fig. 4, are the only place in this state where occurs native tamarack, *Larix laricina*, which is the exclusive host of the following plant bugs in this state: *Deraeocoris laricicola* Knight, *Pilophorus uhleri* Knight, *Plagiognathus laricicola* Knight. These species do not feed on other species of larch used for ornamental planting in various localities, so that our records for the larch mirids are confined to the northern bogs, fig. 5.

Along the shore of Lake Michigan, north of Waukegan, is a narrow sand area, fig.

*This section is the work of Herbert H. Ross, Systematic Entomologist, Illinois Natural History Survey.

3F, which combines a great variety of grass, sedge, herb and shrub species, many of them found nowhere else in the state. This area offers excellent collecting for some of the rarer species of the Miridae. It combines grass, sedge and herb communities, fig. 6, and open woods with luxuriant herbaceous undergrowth, fig. 7. One of our most interesting captures was *Plagiognathus syrticolae* Knight on the sand-loving willow, *Salix syrticola,* restricted in Illinois to this area.

White Pines Forest State Park, fig. 3*B*, in Ogle County, contains an area of white pine forest which is the only large stand of this tree in Illinois, fig. 8. Scattered specimens of the white pine occur in Starved Rock State Park, fig. 3*C*. Restricted to white pine are four mirid species taken in this state: *Deraeocoris pinicola* Knight, which we have taken only at White Pines

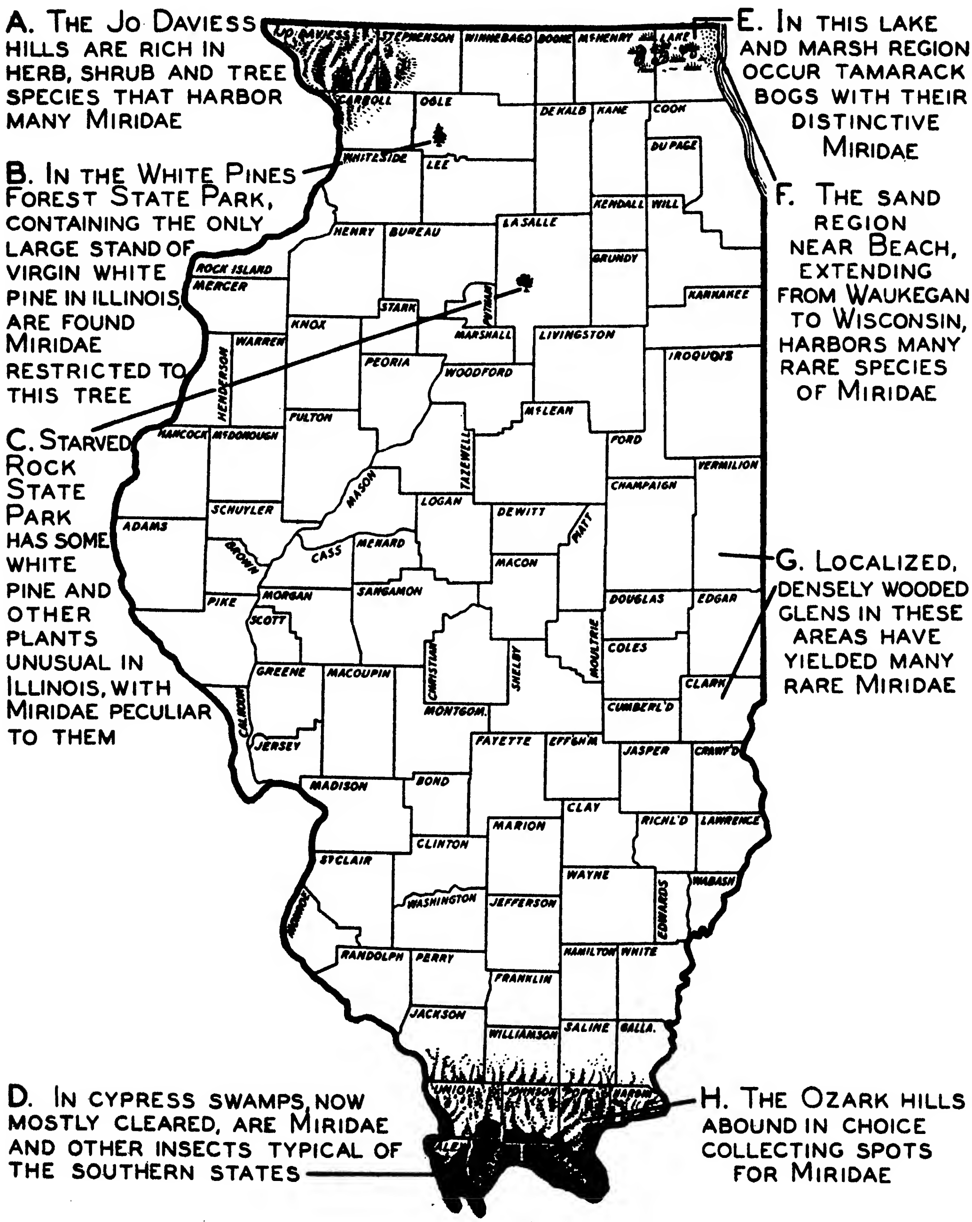


Fig. 3.—Map of Illinois showing mirid habitats of unusual interest.

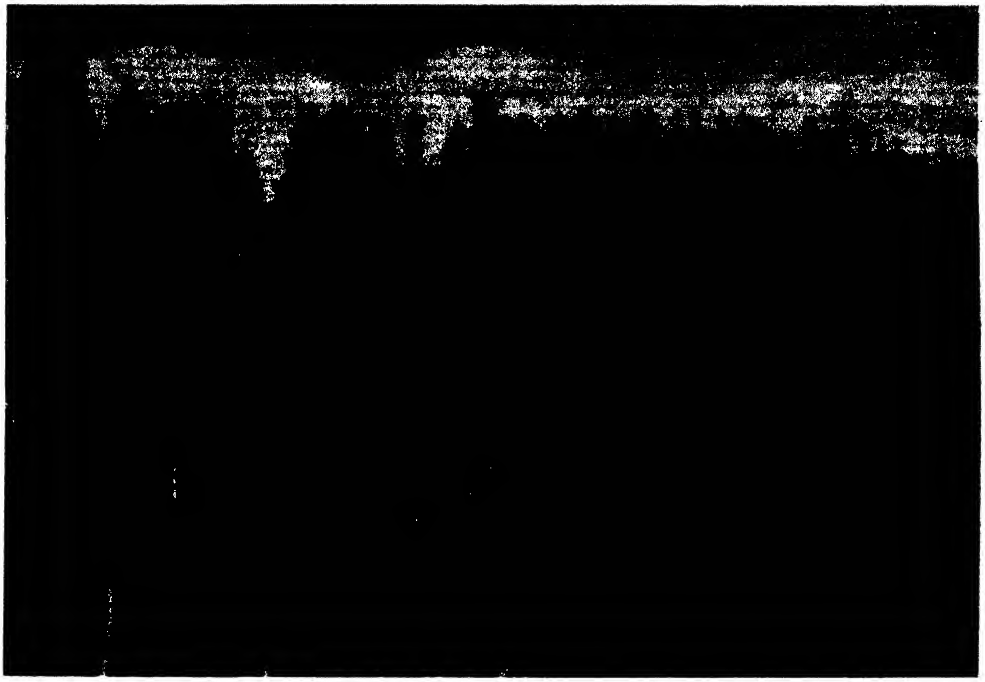


Fig. 4.—(Above.) Tamarack bog at Volo, Ill. Tamarack is the sole host of three Miridae found in Illinois.

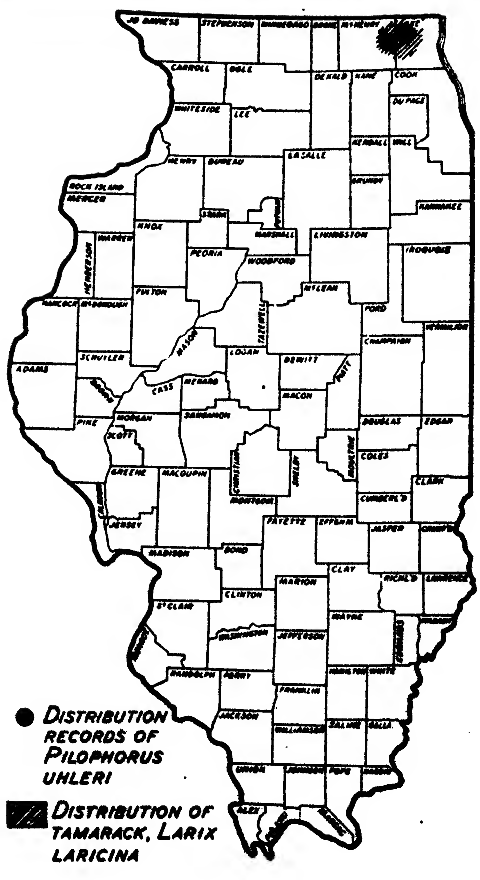


Fig. 5.—(Right.) Map showing the distribution in Illinois of *Pilophorus uhleri*. This species is confined to tamarack, in Illinois found only in the northeastern corner of the state.

Forest State Park; *Deraeocoris nubilus* Knight and *Phytocoris diversus* Knight, which have been taken at both White Pines Forest State Park and Starved Rock State Park; and *Pilophorus strobicola* Knight, which is found not only on these natural stands but also on ornamental white pines throughout the state.

In the extreme southern tip of the state are several fine examples of cypress swamps, fig. 3*D*. Originally cypress swamps covered an extensive area in Alexander, Pulaski and Massac counties, but most of this has been cut over, drained and put into cultivation. There remain, however, one or two cypress areas which have retained their natural biota, such as at Horseshoe Lake, fig. 9. Cypress in Illinois has yielded the following records of Miridae: *Pilophorus taxodii* Knight, *Parthenicus taxodii* Knight, *Orthotylus taxodii* Knight, *Ceratocapsus taxodii* Knight, *Phytocoris taxodii* Knight. All these species are restricted to cypress and have

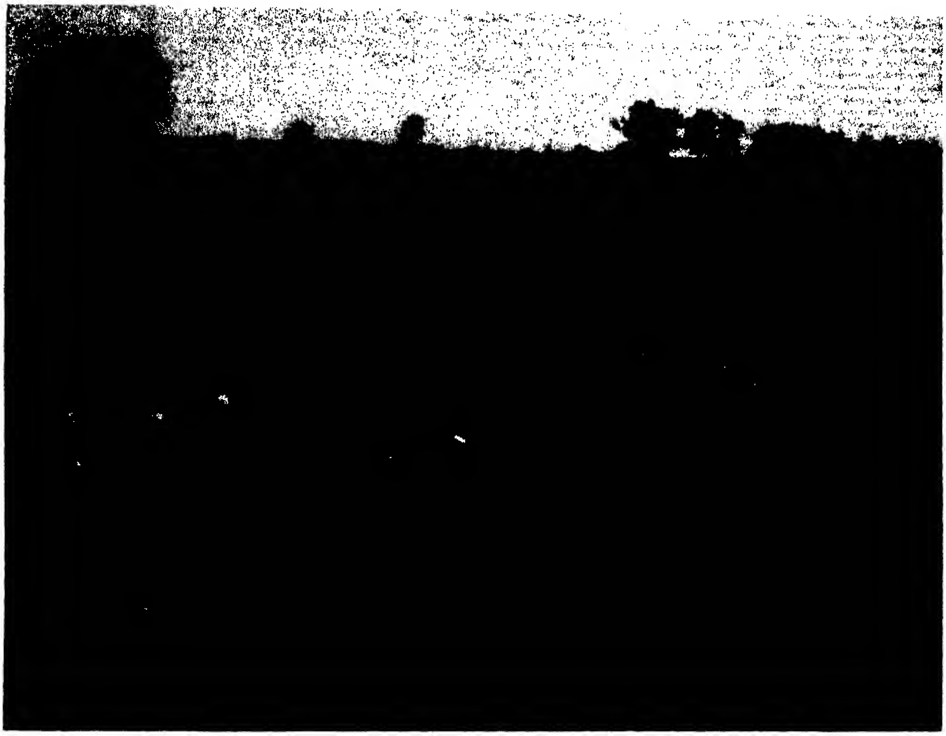


Fig. 6.—Sand prairie vegetation at Beach, Ill., growing on the beaches left by receding Lake Michigan. Note the luxuriant growth of grass and herbs.

been taken in Illinois only in the extreme southern tip, fig. 10.

Forest Mirids

Species of deciduous forest trees, especially ash, oak, hickory and members of the birch family, serve as host for a wide variety of Miridae the distribution of which in general follows that of our forested areas.

A decided peculiarity of the tree-inhabiting Miridae is their preference for forest-edge conditions. A given species will generally be taken in abundance on only those host

Fig. 7.—Older beaches of the sand prairie area near Zion, Ill. Here the forest-edge conditions, with luxuriant vegetation, offer an ideal habitat for many species of Miridae. This area was formerly one of bare, shifting sand.

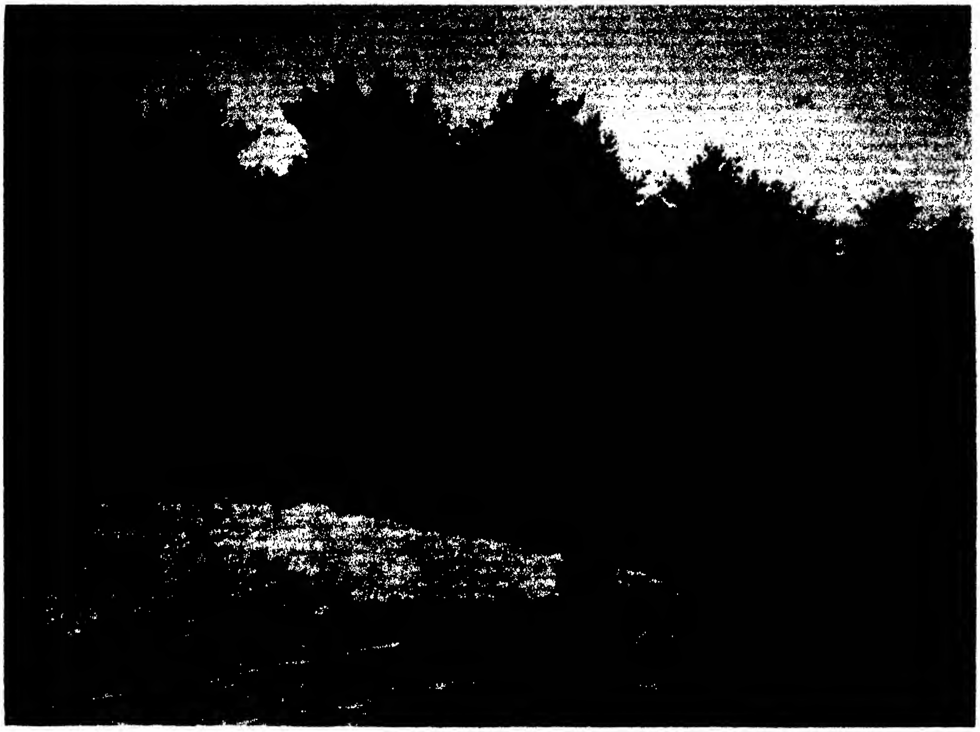


Fig. 8.—Edge of the white pine forest at White Pines Forest State Park, Ill. Four species of Miridae are restricted to white pine, three of them to native stands.

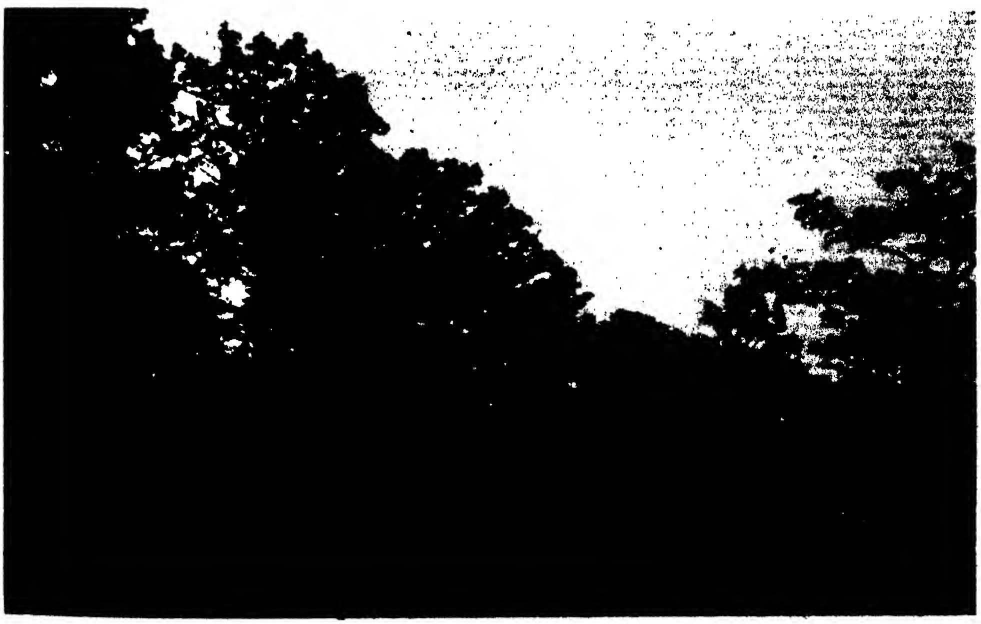


Fig. 9.—Cypress along the shore of Horseshoe Lake, northwest of Cairo, Ill. Five species of Illinois Miridae feed only on cypress trees. Another species, *Phytocoris erectus*, has been collected in this state on cypress, but is known to feed not on this tree but on various other, soft-bodied insects that feed on the cypress.

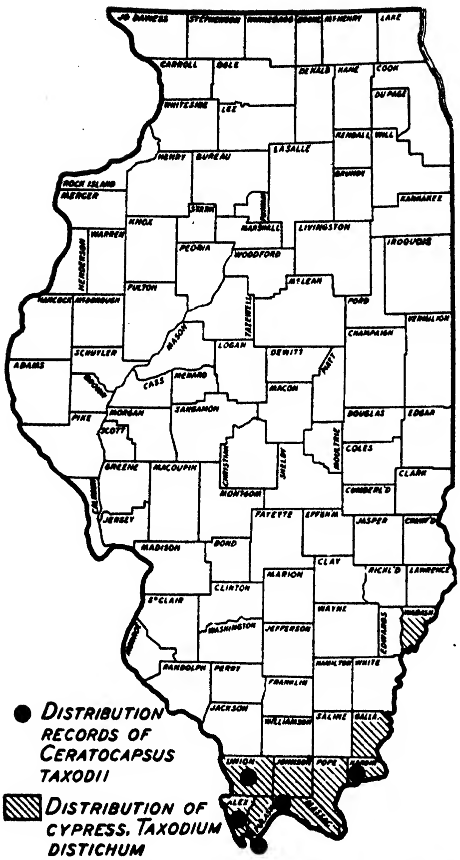


Fig. 10.—Outline map of Illinois showing the distribution of *Ceratocapsus taxodii* and its exclusive host, cypress.

individuals that are at the edge of a clearing, right at the edge of a woods or isolated in the surrounding herbaceous growth. This condition has been found true especially of the species infesting oak and ash. Sweeping in dense woods seldom netted many specimens, but that at odd trees at the edge of the woods frequently resulted in the collection of great numbers of the bugs. This behavior characteristic probably explains why Miridae sometimes become very abundant in street and ornamental plantings of such trees as ash.

Certain forest Miridae are exceptions to this general habit. One of our best examples is *Dicyphus gracilentus* Parshley, which feeds on the herb *Polymnia canadensis*; this bug inhabits deep, shady woods, to which its host is also confined.

We have found collecting of mirids infesting trees and shrubs especially profitable in the Jo Daviess hills, fig. 3*A*, in extreme northwestern Illinois, and in the Ozark hills, fig. 3*H*, in extreme southern Illinois. The Jo Daviess hills are forested and rolling, contain species of *Crataegus* not found farther south and support a flora more varied in nature than most other Illinois areas.

The Ozark hills of southern Illinois are a continuation of the Ozarkian uplift of Oklahoma, Arkansas and Missouri, and have many species of trees, shrubs and herbs that are much more luxuriant there than in other Illinois areas. These species include such forms as alder, red cedar and cane.

Wooded glens especially profitable for mirid collecting occur in several places near the eastern border of the state, fig. 3*G*.

Grass and Marsh Mirids

Certain groups of Miridae, notably the subfamily Mirinae, feed on grasses and some of the sedges and rushes. Some of these

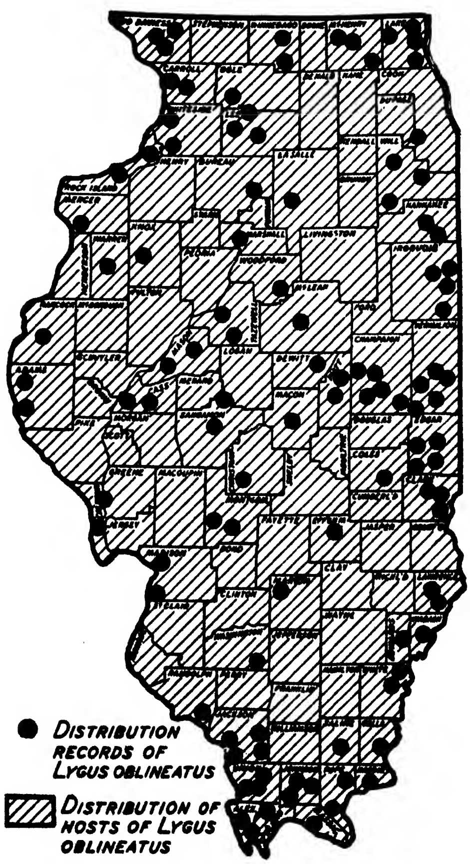


Fig. 11.—Map of Illinois showing distribution of the tarnished plant bug, *Lygus oblineatus*, which feeds on a wide variety of plants.

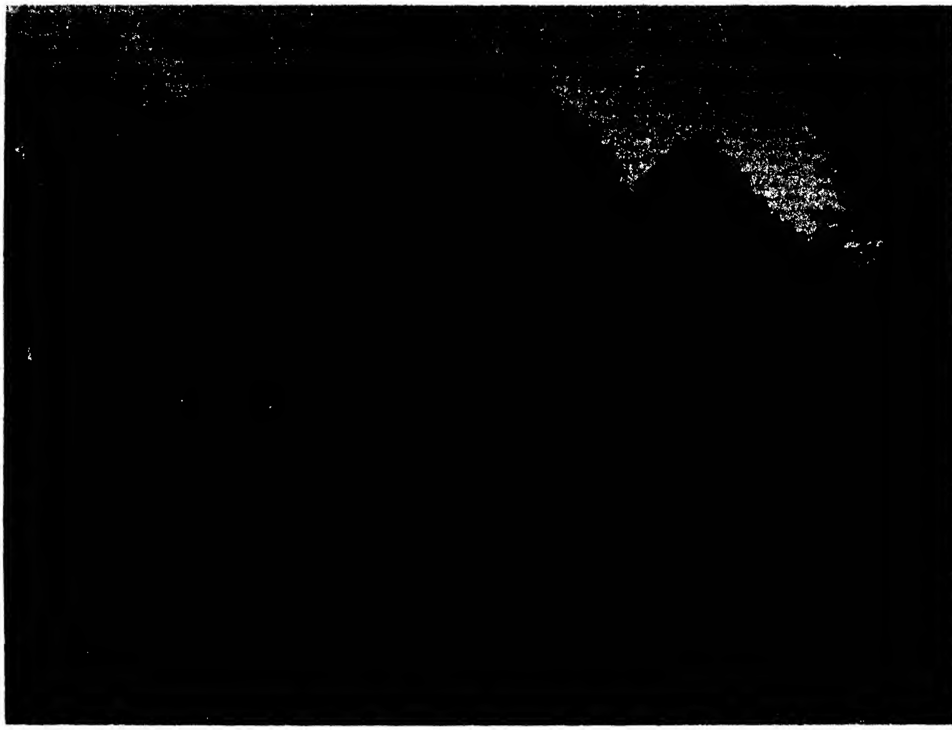


Fig. 12.—Forest edge near Charleston, Ill. Places such as this, with a large variety of trees and shrubs growing near the forest edge, offer good collecting for many species of Miridae.

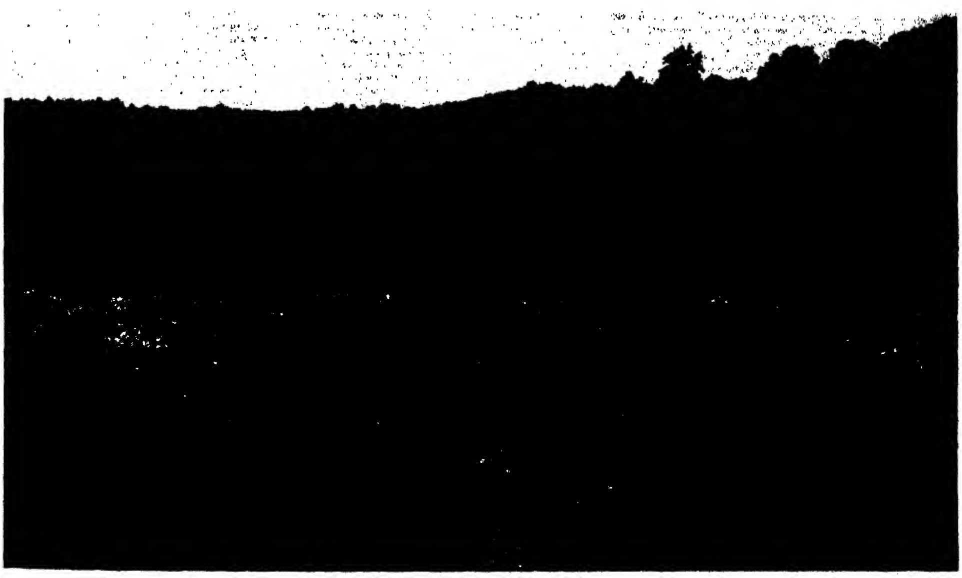


Fig. 13.—Meadows and rolling hills near Herod, Ill. Fencerows, forest edge and meadows combine in many localities in the Ozark hills to give excellent mirid collecting. Several species, such as *Plagiognathus gleditsiae* and *Lepidopsallus nyssae*, known previously only from Gulf Coast states, have been collected in the Illinois Ozarks. Other species, typically northern in distribution, have been collected in this state only in the Ozark hills.

species, such as *Miris dolabratus* (Linnaeus) are widely distributed and feed only on grasses. The range of such species extends over most of the state.

Other plant bugs of this subfamily feed on sedges and rushes, as for example, *Mimoceps insignis* Uhler and *Teratocoris discolor* Uhler, and these are restricted to such local areas as have marsh conditions.

In the bog region of northeastern Illinois, we have many marshes which are excellent collecting grounds for these mirids. While these mirids are not restricted to this region, they are found there more frequently and in greater abundance than in other localities of the state. The sand area along the shore of Lake Michigan combines a great variety of grass, sedge and rush species, and offers excellent collecting for some of the rarer Mirinae.

Widely Distributed Species

A number of favorite plant bug hosts grow in almost every locality in Illinois, and include such familiar forms as ragweeds, cocklebur, willows and some of the grasses. In this category are a large number of weeds, herbs and shrubs. Many of the Miridae feeding on these hosts have an equally wide distribution: *Lygus oblineatus* (Say), feeding on a great variety of herbs and shrubs; *Reuteroscopus sulphureus* (Reuter), feeding on the cut-leaf ragweeds (*Ambrosia* spp.); *Ilnacora stalii* Reuter, feeding on cocklebur; and many others. The distribution map of *L. oblineatus*, fig. 11, shows the wide distribution of this species and serves as a check map for comparing the distribution of other Miridae.

Collecting Notes

It will be seen from the above that the Miridae inhabit practically all the plant communities in Illinois, showing a preference for areas that are borderline between prairie and forest, and that are in the developmental stages approaching the climax forest.

Profitable collecting for a large variety of plant bug species may therefore be found in the forest edge around clearings, fig. 12, or in country with fields, fencerows and woods intermingled, fig. 13. A second equally profitable type of area is that along small streams where a floodplain forest is growing. In both types of situation, many host species are concentrated in a small area.

Economic Status and Control*

The past 25 years have witnessed a decided increase in the number of Miridae that are recognized as economic pests. These are sucking insects which pierce plant tissues and feed on cell liquids, fig. 14.

One of the Miridae of greatest economic importance in Illinois is the tarnished plant bug, *Lygus oblineatus* (Say). This insect causes serious damage to the peach crop. The adult insects hibernate in the fall and leave their winter quarters early in the spring. They feed on the newly set peaches just at the time when the peach petals have fallen, and they are responsible for the blemish commonly known as catfacing, fig. 15. The area surrounding each feeding puncture in the side of the peach grows very little, and on it ordinary peach fuzz does not develop. The result is that when the peach is ripe there is a bare, sunken area, sometimes as much as a half inch across, in the side of the peach. Although these blemishes do not affect the quality of the peach very much, they throw the fruit out of grade. In certain years as much as 7 to 8 per cent of all peach fruit in an orchard is affected.

Dusting with very fine sulfur at the time petals are falling has shown some benefits in peach orchards.

This insect also feeds on the new shoots of nursery stock, causing what is called "stopback" or "dieback." It injures a number of fruits by feeding on the buds. The feeding punctures of this species may cause malformation in the flowering buds of asters and strawberries. In orchards the insect may attack the buds and young fruits of apples and peaches. It also feeds on beet, chard, celery, bean, potato, cabbage, cauliflower, turnip, salsify, cucumber, cotton, tobacco, alfalfa, many flowering plants, and most deciduous and small fruits—more than 50 economic plants, besides many weeds and grasses.

The tarnished plant bug is such a general feeder and so widely distributed, and is at

*W. P. Flint, Chief Entomologist, Illinois Natural History Survey and Agricultural Experiment Station, cooperated in writing this section, supplementing it with his knowledge of economic insect control methods in Illinois over a long period of years.

the same time such an active insect, that no satisfactory method of control has been developed.

The garden flea hopper, *Halticus bracteatus* (Say), is a pest of considerable importance on white clover and other leguminous crops in Illinois. In Missouri, it sometimes destroys garden bean crops completely. In South Carolina and neighboring states this tiny bug occasionally destroys 50 to 60 per cent of the alfalfa crop.

The cotton flea hopper, *Psallus seriatus* (Reuter), is a serious pest of cotton, more important in Texas, Oklahoma, Georgia and South Carolina than in Illinois. In some years it is reported as causing greater losses than the boll weevil. Both nymphs and adults of this flea hopper feed on the tiny flower buds of cotton, causing them to drop; the feeding habits of the bugs may also cause the plant to grow tall and spindly, resulting in a light set of cotton squares. This insect may be controlled in cotton fields by fine sulfur dusts. Almost complete freedom from damage may be obtained by the use of these materials. The abundance of this insect is dependent on certain ecological factors, particularly any condition that favors abundant growth of the wild hosts, the various species of *Croton*.

The apple redbug, *Lygidea mendax* Reuter, a potential pest of apples in Illinois, has not yet been found in this state. In parts of the East it is very abundant. Its feeding causes dents or dimples in the apple, and areas of hardened tissue which throw the fruit out of grade. It also damages the apple crop by feeding on small fruit, causing excessive shedding of the apples, with scars and malformed fruit if growth continues. Some infested orchards have had at picking time 25 to 30 per cent of the fruits culled out as a result of malformations caused by the redbug.

This species is easily controlled by adding nicotine sulfate to the pink bud spray or by nicotine dusts, since the nymphs are delicate and very sensitive to these materials, but in Illinois it is not now necessary to put on an application for their control.

The four-lined plant bug, *Poecilocapsus lineatus* (Fabricius), attacks many cultivated plants, such as currant, gooseberry, parsnip, mint and some other truck crops, as well as dahlia and rose. In Illinois, it fluctuates greatly in abundance. In certain years it pays to apply a nicotine dust for its control.

The bright red nymphs puncture leaves and tender shoots, sucking sap; every puncture produces a reddish spot, the leaves curling as the growth of the plant is checked.

The pear plant bug, *Neolygus communis* Knight, may leave its natural host, dogwood (*Cornus* sp.), and colonize on pear trees. The nymphs feed on the small pears, causing

Fig. 14.—Mirid injury. White spots on leaves of ash (*Fraxinus* sp.) are feeding punctures of plant bugs, in this case *Neoborus amoenus*. This type of injury is typical of most mirid feeding.

knotty, malformed fruit. Although the Illinois pear crop is not of great commercial importance, the insect causes an appreciable amount of damage. As is the case with the tarnished plant bug, no really satisfactory method of control under Illinois conditions has been developed.

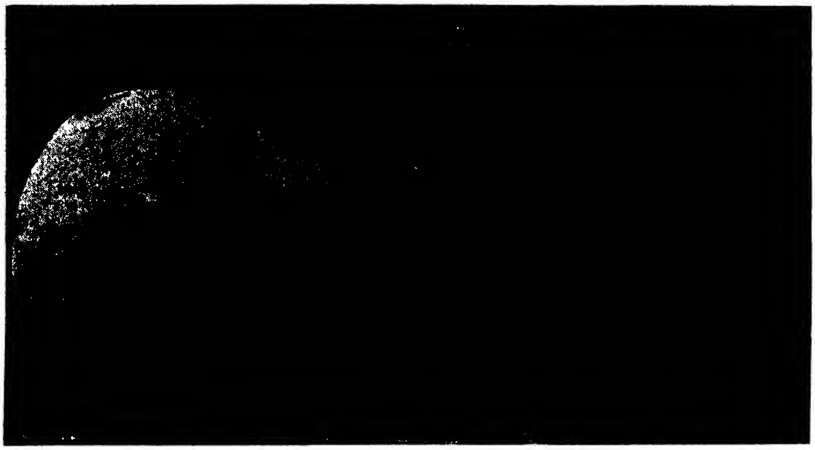


Fig. 15.—Mirid injury. Catfacing of peaches caused by *Lygus oblineatus*. A similar type of injury by plant bugs is common in various fruits in Illinois.

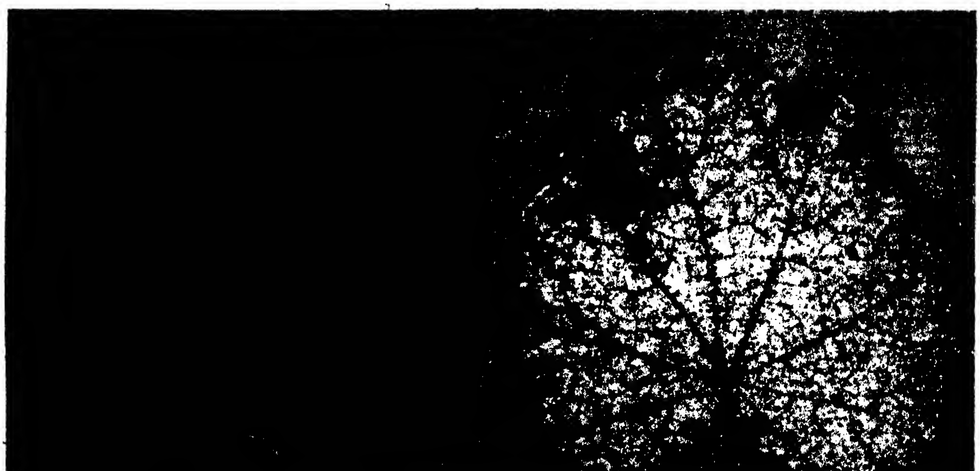


Fig. 16.—Mirid injury. Extreme injury to hollyhock foliage by the plant bugs *Melanotrichus althaeae* and *Halticus bracteatus*. Note in leaf at right almost complete etiolation or destruction of green coloring matter, caused by feeding of these bugs. Similar damage frequently occurs on grasses, onions, phlox, clover and other plants by various mirid species.

Brittain (1917) describes serious injury to apples in Nova Scotia by the green apple bug, *Neolygus communis* var. *novascotiensis* Knight.

The onion plant bug, *Labopidea allii* Knight, is not usually of any great importance on cultivated onions in Illinois, but in other states it often becomes so abundant on Bermuda onions that the plants are killed before growth is completed. It is very common on wild onions and wild garlic, but perhaps may be considered a beneficial insect in this respect rather than a plant pest.

The phlox plant bug, *Lopidea davisi* Knight, breeds on wild phlox but is often found colonizing on cultivated phlox and causing serious injury to these ornamental plants. The bug can be controlled by the use of a nicotine spray or dust, or by pyrethrum

sprays or dusts. It is an insect that should be looked for every year.

The hickory plant bug, *Neolygus caryae* Knight, may migrate from its natural host to peach trees, where the adults puncture and suck sap from the young fruit. It causes some injury to peaches, which is similar to that of the tarnished plant bug. Serious damage by this insect has been reported from New York and Ohio.

In several western states the legume bug, *Lygus hesperus* Knight, causes considerable loss in alfalfa seed due to puncturing and feeding by the bugs on the flower buds. The pale legume bug, *L. elisus* Van Duzee, does similar damage, but in most localities this species is outnumbered by *L. hesperus*. In the upper Mississippi River valley the alfalfa plant bug, *Adelphocoris lineolatus* (Goeze), is extremely abundant on alfalfa and sweet clover and may prove to be a pest where these crops are grown for seed production.

Other species of Miridae that are from time to time reported as pests are hop plant bug, *Paracalocoris hawleyi* Knight, on hops; hollyhock plant bug, *Melanotrichus althaeae* (Hussey), fig. 16; meadow plant bug, *Miris dolabratus* (Linnaeus), on timothy and other grasses; and the rapid plant bug, *Adelphocoris rapidus* (Say), on cotton in the South.

Taxonomy

The Miridae are distinguished by four-segmented antennae, a four-segmented rostrum of which the first segment is as long as or longer than the head, three-segmented tarsi (except *Peritropis* in which they are two-segmented), wing membrane with only two cells or areoles, one longitudinal vein (anal vein), a well-developed cuneus on the wing, and by absence of ocelli, fig. 17. The four-segmented antennae are usually slender, nearly linear or the second segment only slightly thickened apically, but in a few genera strongly thickened as in *Capsus, Atractotomus* and *Teleorhinus*; third and fourth segments usually slender but in some forms distinctly thickened as in *Ceratocapsus*. The hemelytra are typically separated into clavus, corium, cuneus and membrane, the embolium usually not clearly separated from corium; veins of membrane forming two cells, a small and larger areole; however, in a number of species the hemelytra may be abbreviated (brachypterous), the membrane almost absent or reduced to a narrow band with veins poorly indicated. Modifications of the arolia, the pulvillaelike structures between the tarsal claws, furnish the most reliable characters for separating the subfamilies.

In general, the Miridae are small to medium in size, from 2.0 to 9.5 mm. in length, usually rather fragile, broader than high and longer than broad; as viewed from above, ovate to oblong, but in a few genera rather slender, as in *Trigonotylus*. The male is usually more slender than the female. The body is variously clothed with fine hairs or pubescence, sometimes modified to form sericeous or scalelike hairs, which are easily shed; frequently the dorsum is practically glabrous and strongly shining. The numerous species exhibit the greatest variety of color patterns, ranging from the most obscure to forms that are vivid red. Color varieties within the species are frequent, and the two sexes are more often differently colored, the male usually darker colored than the female.

Brachypterous and apterous forms occur throughout the family, and individuals of a single species may exhibit variation in this respect, as in *Halticus bracteatus* (Say) and *Miris dolabratus* (Linnaeus). Usually the male is macropterous even when the female is apterous, but in rare cases the male may be apterous. Ant mimic forms are rather numerous among the Miridae, especially in species of *Coquillettia, Sericophanes* and *Pilophorus*. In such forms the abdomen is constricted at the base while the head and thorax are so modified the resemblance to ants is unmistakable. The species of *Sericophanes* and *Coquillettia* are generally found upon the ground running about among ants, but the biological relationship, if any, has not been determined. In Iowa the writer has found *Sericophanes heidemanni* Poppius rather abundant on the ground among short grasses and weeds of closely cropped pasture land; the bugs running about where the little brown ants, *Lasius niger alienus* var. *americanus* Emory, were very abundant. At Fort Snelling, Minnesota, in an area of little disturbed, high, prairie vegetation, particularly among the shorter grasses, the writer found and collected a large series of *Coquil-*

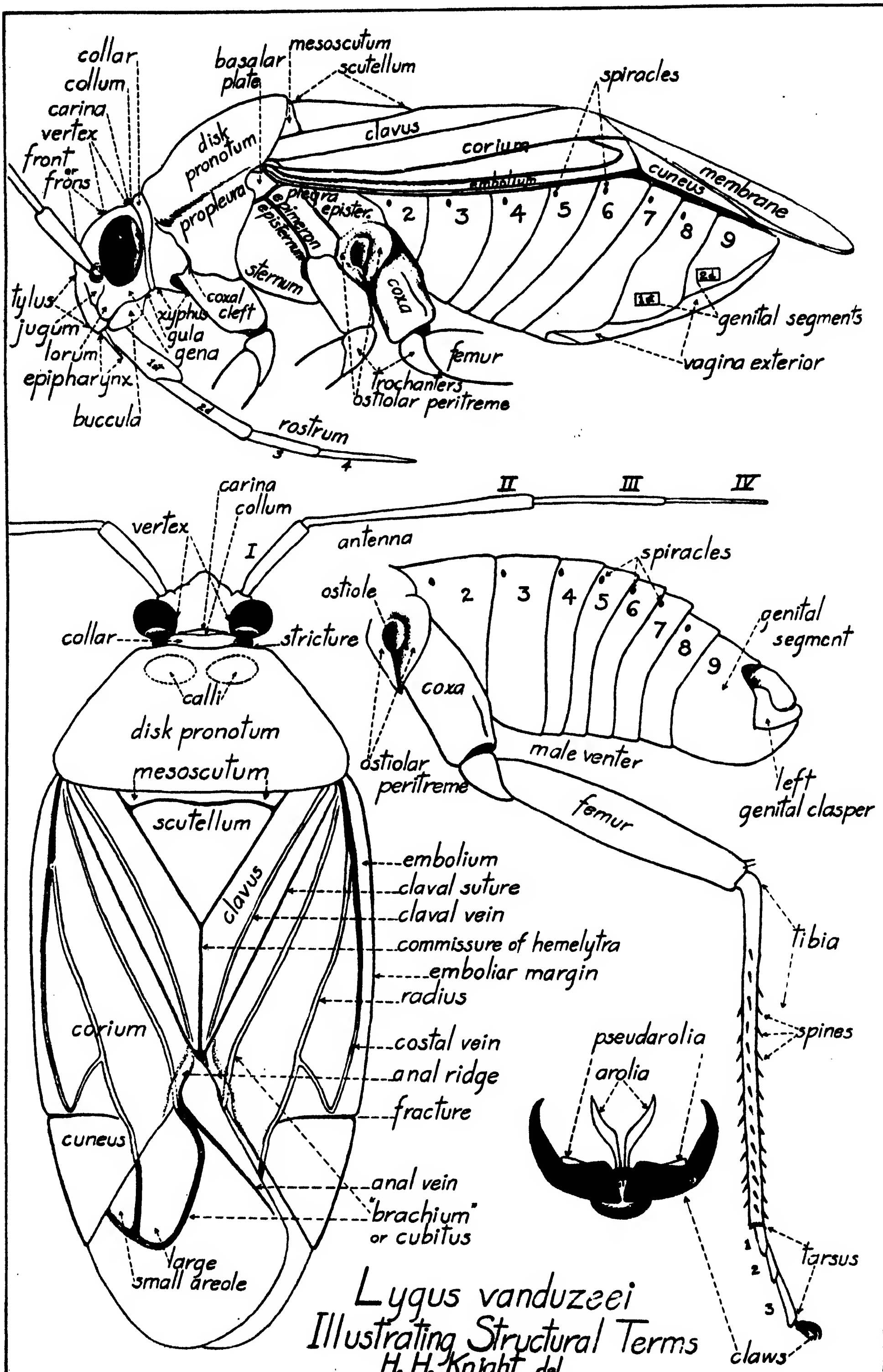


Fig. 17.—*Lygus vanduzeei*, showing typical mirid structures and illustrating structural terms.

lettia amoena (Uhler) from an area which abounded with the ant, *Formica* (*Neoformica*) *pallide-fulva* var. *incerta* Emory. The wingless females so resemble this ant in form and color that one must look rather closely to separate them. Miridae of the above species of *Sericophanes* and *Coquillettia* are extremely agile and very rapid of movement, especially when they happen to meet face to face with ants. While they seem not to fear the ants, they appear to avoid close contact with them.

Systematic Characters

The most important character for separation of subfamilies is found in the structure of the arolia, situated between and at the base of claws, fig. 17. In the subfamilies Phylinae and Deraeocorinae the arolia are represented by a pair of erect bristles that are difficult to see in the smaller species. The arolia are erect and well developed in the Orthotylinae, Mirinae and Capsinae; arolia converging at tips in Orthotylinae and diverging apically in the Mirinae and Capsinae. Pseudarolia are clear to white in color and occur on inner curvature of claw near base. The pseudarolia are found in the Phylinae but are larger and more prominent in the Dicyphinae and Bryocorinae.

The form of the male genital segment is rather distinctive in the subfamily Phylinae; the genital claspers are relatively small, with tip of right clasper resting in a notch across the middle of the V-shaped left clasper; both oedagus and claspers are twisted somewhat to the left side. The author believes this particular form of genital segment is a fundamental character of this subfamily. In other subfamilies the male genital segment often presents good characters for the separation of genera as well as species. Specific differences are more likely to be found in the male claspers, which are asymmetrical in form and differ among the species in many genera. It is fortunate that in several of the largest genera the numerous species may be identified by the form of the genital claspers, as in *Phytocoris, Neolygus, Lopidea, Orthotylus, Ceratocapsus* and *Deraeocoris*. On the other hand, in several sizable genera such as *Paracalocoris, Neurocolpus* and *Neoborus* the male genital claspers appear to be of little value for distinguishing species. Fortunately, in *Paracalocoris* and *Neurocolpus* the length of antennal segments and form of pubescence offer very good characters for separating species. Thus it appears that a particular set of characters may not have equal value throughout the family.

Among the Miridae, pubescence often provides useful characters; it varies from simple, fine hairs, erect or recumbent, to silky, slightly curled pubescence, or even flattened, scalelike hairs. The scalelike pubescence found on several species of *Phytocoris* and in the genus *Halticus* is easily shed or lost; hence specimens should be collected and preserved with great care.

The shape of the head and thorax is much used for generic characters; minor differences may indicate species. The length of the rostrum may be of generic value but more frequently it differs among the species and may form good distinctions, as in *Polymerus* and *Lygus*. The antennae are generally linear in form with the last two segments very slender. However, some genera may be separated by the exceptional form of the different segments; the second segment is strongly thickened in *Capsus, Atractotomus* and *Teleorhinus;* the third and fourth segments are usually slender, but in some genera, as *Ceratocapsus*, they are distinctly thickened.

Phylogeny

Nine subfamilies of Miridae are recognized from North America and all of them are found in the state of Illinois. The phylogeny of these subfamilies does not present a linear series of development, but more of a progression upward in several directions, which perhaps may best be represented by a genealogical tree, fig. 18, to express the relationships within the family. These relationships are based on the following characters, which are listed in the order of their relative importance: (1) arolia, (2)

Fig. 18.—Genealogical tree showing relationship of mirid subfamilies.

genital structures, (3) biology, (4) modifications of the thorax.

The position and height of the tree branches indicate the evolutionary relationships of the subfamilies, while the width of the branches indicates the relative number of species. For instance the Mirinae are highly developed structurally but very old and decadent in number of species; the genera and species are few in number but most of them are very widely distributed. The host plants of the Mirinae are confined to the grasses and sedges, families that are among the oldest and most widely distributed plant groups. On the other hand the Capsinae are more recent in development, structurally more specialized with arolia and genital structures highly developed; the species are very abundant, often limited in distribution, and for host plants utilize all the more recent plant families. Species of the subfamily Orthotylinae resemble the Phylinae most by absence of the thoracic collar, but the erect incurved arolia come nearest in form to the Capsinae; the genital claspers are highly modified and specialized.

Present Holders of Material: Symbols

If not otherwise noted the material listed in this paper belongs to the Illinois Natural History Survey. Material in the collections of other institutions or individuals is so designated by the use of the following symbols.

FM—Field Museum of Natural History, Chicago, Ill.

KC—Knight Collection, Iowa State College, Ames, Iowa.

UI—University of Illinois, Urbana, Ill.

USNM—United States National Museum, Washington, D. C.

Measurements and Records

Measurements given in this paper, *e.g.*, "length 5.80, width 2.48," are uniformly in millimeters. These are standard with other literature on insect taxonomy.

In any previously described species in which more than 10 Illinois records are available, the places are listed and the dates summarized.

Tarsal Claw Key Characters

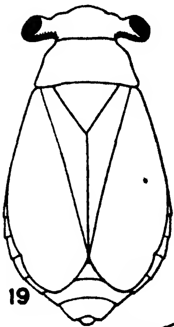
The student wishing to identify Miridae should acquaint himself with the structures of the tarsal claws. These claws are used in identifying most of our forms to subfamily and sometimes to genus. It is highly desirable that the student examine a selection of different kinds of mirids to acquaint himself with the various conditions of the arolia and pseudarolia on the tarsal claws.

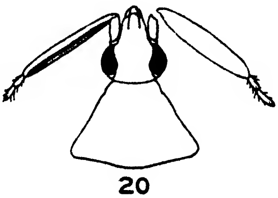
The claws are best examined at high magnifications against a dark background. If possible, it is well to examine them with both compound microscope and stereoscopic binocular.

The tarsal claws are situated at the extreme end of the third tarsal segment, fig. 23. The simplest type is shown in fig. 24, which has a pair of hairlike arolia arising from the area between the base of the claws. In some groups, these arolia are membranous and thickened; in such cases, they are either convergent at apex, fig. 25, or divergent at apex, fig. 26. These two membranous types are generaly readily visible without any doubt as to their structure. In other groups are cushionlike or flaplike membranous areas called pseudarolia attached to the claw itself. These may be very small; they may be present in instances where the arolia are either hairlike or membranous. In Illinois species, they are never large if the arolia are membranous. Among the species in which the arolia are hairlike, these pseudarolia are often quite large. Fig. 27 shows an example in which the pseudarolia are large and joined to the claw over a large surface; figs. 28 and 29 illustrate an example in which the pseudarolia are flaplike and attached to the claw only at its base.

KEY TO SUBFAMILIES

1. Scutellum with a dorsal projection, figs. 137, 181 2
   Scutellum without a dorsal projection. 3





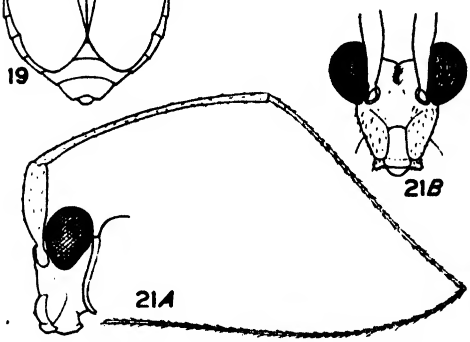


Fig. 19.—Head and body of *Labops hirtus.*

Fig. 20.—Head and pronotum of *Hesperophylum heidemanni* showing dorsal view of antenna at left, anterior flat view at right.

Fig. 21.—Head of *Cylapus tenuicornis:* *A*, lateral view; *B*, dorsal view.

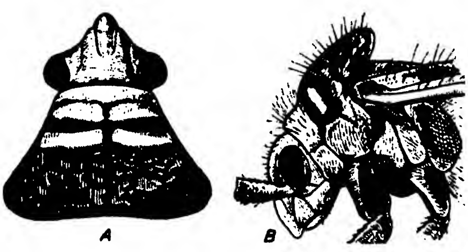
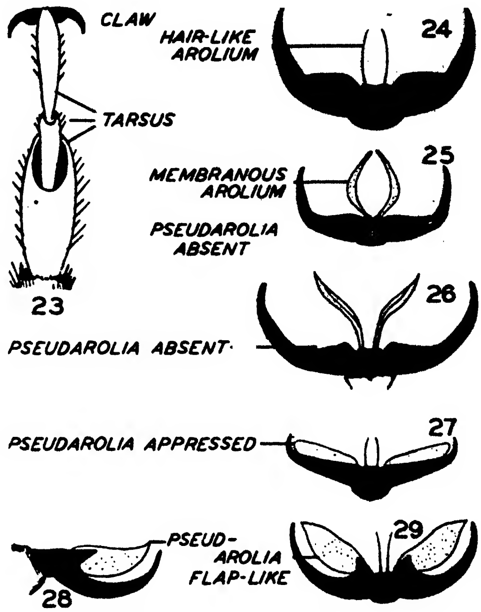


Fig. 22.—Head and pronotum of *Semium hirtum:* *A*, dorsal view; *B*, lateral view.

2. Pronotum with anterior half flat, posterior half swollen, fig. 181 (*Barberiella*, p. 209).... **Capsinae,** p. 131
   Pronotum with only anterior fifth flat, posterior four-fifths forming a high, swollen area, fig. 137 (*Cyrtopeltocoris*, p. 117)........ **Orthotylinae,** p. 74
3. Eyes attached to a stalk formed by a round lateral projection of head; head very wide and short, fig. 19 .... **Labopini,** p. 81
   Eyes not stalked, figs. 20, 113........ 4
4. Eyes rising a considerable distance above dorsum of head; head deep, with a furrow down the meson and the ventral margin wide and truncate, fig. 21......... **Cylapini,** p. 61
   Eyes not rising appreciably above dorsum of head.................. 5



MIRID TARSAL CLAWS

Fig. 23.—*Monalocoris filicis.*
Fig. 24.—*Largidea davisi.*
Fig. 25.—*Diaphnidia pellucida.*
Fig. 26.—*Pithanus maerkelii.*
Fig. 27.—*Teleorhinus davisi.*
Fig. 28.—*Dicyphus agilis.*
Fig. 29.—*Dicyphus agilis.*

5. Pronotum as in fig. 22, with anterior fourth membranous, remainder velvety and dark, with a pair of conspicuous, narrow membranous areas near anterior margin of dark portion; pleural area separated from notum by a suture (*Semium*, p. 75) .... **Orthotylinae,** p. 74
   Pronotum otherwise, without a pair of narrow, membranous areas on a velvety area; seldom with a suture separating pleural areas and notum. 6
6. Antennae with second segment bilaterally compressed, foliaceous, nearly

three times as high as wide, and black; third and fourth segments very short, fig. 20 (*Hesperophylum*, p. 19)........**Deraeocorinae,** p. 64

Antennae with second segment cylindrical or almost so, or third segment three-fourths as long as second, fig. 92............................ 7

7. Tarsal claws with only a pair of straight hairs between them, figs. 30–41, sometimes also with a small, inconspicuous, membranous area appressed to inner margin of claw, figs. 38–41............................13

Tarsal claws with a pair of prominent, whitish, membranous lobes between them; these lobes either curved and fingerlike, figs. 54–67, or flaplike, figs. 42–53...................... 8

8. Tarsal claws with membranous lobes fingerlike and arising from between bases of claws (true arolia); these either divergent, figs. 63–67, or convergent, figs. 54–62, at apex........ 9

Tarsal claws with membranous lobes flaplike (pseudarolia), arising from inner margin of claw itself, figs. 42–53; frequently hooked to form a recess from which the pseudarolia appear to arise, fig. 52............18

9. Arolia convergent at apex, figs. 54–62. ....**Orthotylinae,** p. 74

Arolia divergent at apex, figs. 63–67...10

10. Pronotum with a prominent ridge running from the postero-lateral corner of the pronotum almost to the anterior corner, fig. 69; and with pleural suture situated some distance from anterior margin and terminating under ridge.........**Mirinae,** p. 124

Pronotum with this ridge either absent or represented for only a short distance..........................11

11. Posterior portion of head elongate, fig. 143, so that the eyes are situated their own length from pronotum (*Collaria*, p. 126)...**Mirinae,** p. 124

Posterior portion of head short so that the eyes almost touch or do touch the pronotum, fig. 154.......12

12. Pronotum markedly widest at posterior margin, figs. 155, 180; hemelytra with corium and cuneus distinctly defined as sclerotized areas and set off from the apical membrane...... ....**Capsinae,** p. 131

Pronotum swollen at middle, this portion as wide as or wider than hind margin, fig. 142; hemelytra with corium and cuneus merging so imperceptibly with the membrane, which is partially sclerotized, that there is no line of distinction between them; includes both macropterous and brachypterous forms.......... ....**Mirinae,** p. 124

13. Calli greatly enlarged into a pair of broad humps occupying the anterior two-thirds of the central area of the pronotum, fig. 68.....**Fulviini,** p. 61

Calli much smaller, fig. 70; pronotum not humped anteriorly, but usually considerably humped posteriorly...14

14. Anterior margin of pronotum with a distinct, even, ringlike collar set off by a definite, deep groove, fig. 70...15

Anterior margin of pronotum without a ringlike collar, fig. 77; at most with a flattened area, fig. 78.......17

15. Pronotum narrowed to a distinctly necklike anterior portion; head narrowed posteriorly and appearing stalked; hemelytra colorless, transparent and glassy with a Y-shaped red or fuscous mark, fig. 98 (*Hyaliodes*, p. 57).......**Dicyphinae,** p. 52

Pronotum not greatly narrowed anteriorly, figs. 70, 71; head sometimes narrowed posteriorly but not stalked, fig. 71; hemelytra not colorless and glassy..........................16

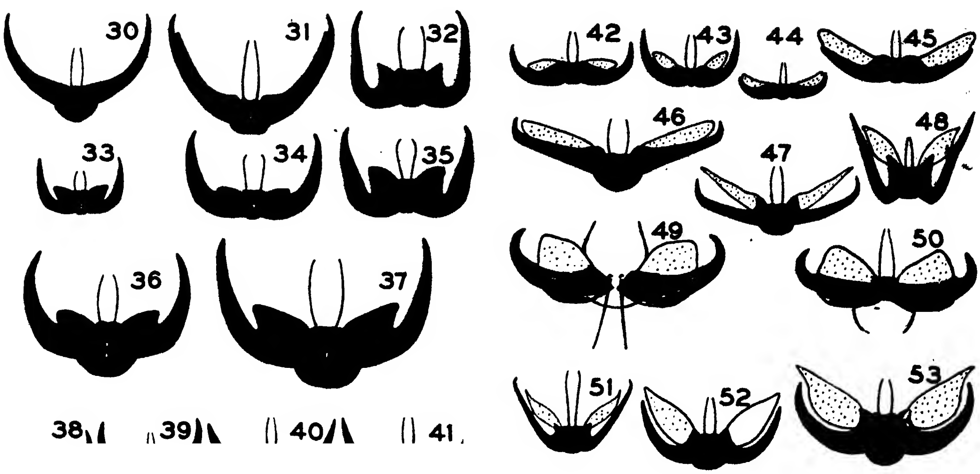
16. Eyes distinctly removed from posterior margin of head, fig. 71; pronotum with calli represented by a smooth, depressed shining area forming a second "collar," fig. 71............ ....**Clivinemini,** p. 64

Eyes bordering on posterior margin of head, figs. 70, 105; pronotum with calli not depressed below level of adjacent area of pronotum........ ....**Deraeocorinae,** p. 64

17. Anterior portion of pronotum set off by a dark, impressed line running from antero-lateral corner to posterior margin of calli, fig. 72............. ....**Largideini,** p. 63

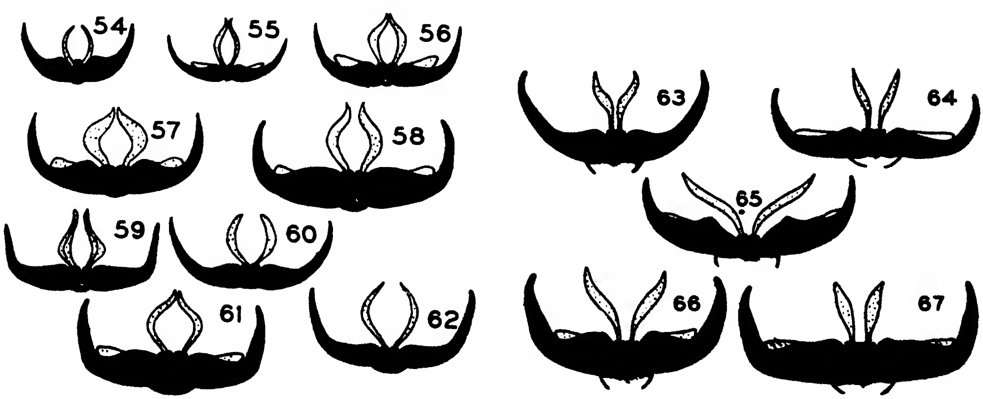
Anterior portion of pronotum without such a line, figs. 77, 79............ ....**Phylinae,** p. 22

18. Dorsal outline almost circular, fig. 99, and pronotum with narrow, ringlike



MIRID TARSAL CLAWS

Fig. 30.—*Fulvius brunneus.*
Fig. 31.—*Cylapus tenuicornis.*
Fig. 32.—*Hyaliodes vitripennis.*
Fig. 33.—*Deraeocoris nebulosus.*
Fig. 34.—*Deraeocoris pinicola.*
Fig. 35.—*Deraeocoris ruber.*
Fig. 36.—*Eurychilopterella luridula.*
Fig. 37.—*Eustictus venatorius.*
Fig. 38.—*Microphylellus modestus.*
Fig. 39.—*Psallus ancorifer.*
Fig. 40.—*Rhinocapsus vanduzeei.*
Fig. 41.—*Criocoris saliens.*
Fig. 42.—*Microsynamma bohemanni.*
Fig. 43.—*Reuteroscopus ornatus.*
Fig. 44.—*Chlamydatus associatus.*
Fig. 45.—*Lopus decolor.*
Fig. 46.—*Orectoderus obliquus.*
Fig. 47.—*Coquillettia mimetica.*
Fig. 48.—*Dicyphus famelicus.*
Fig. 49.—*Pycnoderes dilatatus.*
Fig. 50.—*Sixeonotus insignis.*
Fig. 51.—*Dicyphus discrepans.*
Fig. 52.—*Macrotylus sexguttatus.*
Fig. 53.—*Macrolophus separatus.*



MIRID TARSAL CLAWS

Fig. 54.—*Parthenicus vaccini.*
Fig. 55.—*Halticus bracteatus.*
Fig. 56.—*Halticus intermedius.*
Fig. 57.—*Strongylocoris stygicus.*
Fig. 58.—*Heterocordylus malinus.*
Fig. 59.—*Ceratocapsus modestus.*
Fig. 60.—*Labops hirtus.*
Fig. 61.—*Ilnacora malina.*
Fig. 62.—*Orthotylus flavosparsus.*
Fig. 63.—*Stenodema trispinosum.*
Fig. 64.—*Phytocoris lasiomerus.*
Fig. 65.—*Barberiella apicalis.*
Fig. 66.—*Lygus vanduzeei.*
Fig. 67.—*Platytylellus insitivus.*

collar well marked, fig. 73 (*Monalocoris*, p. 58).......**Bryocorinae**, p. 58

Either dorsal outline much more elongate, fig. 97, or pronotal collar absent, fig. 77....................19

19. Tibiae without spines, only hair. Short, robust species, figs. 100, 101, with the pronotum greatly swollen posteriorly and the areole demarked by a single, angulate, thick vein (*Sixeonotus*, p. 59, and *Pycnoderes*, p. 60) ....**Bryocorinae**, p. 58

Tibiae with spines which project beyond hair, fig. 17; either more elongate, slender species, fig. 97; or pronotum only moderately enlarged posteriorly, fig. 87; or areole divided into large and small parts, fig. 17...20

20. Pronotum wide, without collar or collarlike area, figs. 77, 87.......... ....**Phylinae**, p. 22

Pronotum narrower, anterior portion somewhat necklike, with a collar or collarlike flat area, figs. 78, 97......21

21. Hind tarsi very long and slender, fig. 74; second segment very long, claws small............**Dicyphinae**, p. 52

Hind tarsi stouter, figs. 75, 76; second segment not much longer than third.22

22. Hind tibiae with a few black spines at apex, fig. 76; tarsal segments robust; tarsal claws long, figs. 46, 47, sharply curved at extreme apex........... ....**Phylinae**, p. 22

Hind tibiae with no black spines at apex, fig. 75; tarsal segments bilaterally compressed; tarsal claws short, figs. 52, 53, evenly curved from base ....**Dicyphinae**, p. 52

PHYLINAE

KEY TO GENERA

1. Pronotum nearly triangular with a more or less flattened apical collar, but this collar not set off from disk of pronotum by a distinct carina, fig. 78; abdomen usually constricted at base, as in fig. 136............ 2

Pronotum wider without a flattened apical collar, figs. 77–79; abdomen never constricted at base......... 4

2. Second antennal segment strikingly clavate, its thickness at apex more than twice that at base; beak reaching almost to hind coxae; hemelytra fully developed in both sexes... ....**Teleorhinus**, p. 52

Second antennal segment linear or slightly thickened at apex, fig. 80; beak reaching middle coxae; females brachypterous or wingless........ 3

3. Second antennal segment linear; pseudarolia attached at base of claw, free apically, fig. 47; females wingless........**Coquillettia**, p. 52

Second antennal segment slightly thickened at apex, fig. 80; pseudarolia completely jointed to claw, fig. 46; females brachypterous........ ....**Orectoderus**, p. 52

4. Cuneus white or very light yellow, with transverse black bar across middle; membrane dark brown or black, with prominent white marginal spots, fig. 93; pseudarolia large, attached only at basal angles and extending free and parallel with claws to tips, fig. 52.............. ....**Macrotylus**, p. 51

Wings not marked as in fig. 93; pseudarolia large and completely united with claws, fig. 46; or pseudarolia minute or wanting, figs. 38–43.... 5

5. Vertex and pronotum bearing silvery, scalelike hairs, these hairs sometimes in tufts................... 6

Vertex and pronotum not bearing silvery, scalelike hairs.............11

6. Head transverse, front vertical, not protruding in front of antennal bases as seen from dorsal aspect... ....**Rhinacloa**, p. 50

Head produced in front of antennal bases, fig. 89................... 7

7. Tylus sharply produced, apex acute, fig. 91.............**Criocoris**, p. 49

Tylus not produced, apex blunt..... 8

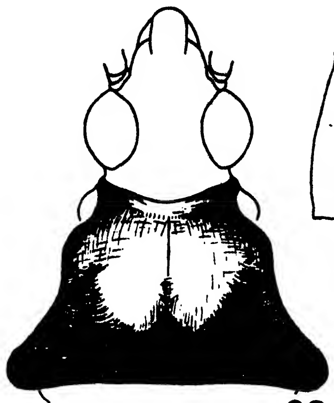
8. Second antennal segment strongly thickened.....**Atractotomus**, p. 51

Second antennal segment linear, not thicker than first segment........ 9

9. Length of second antennal segment less than width of head across eyes ....**Lepidopsallus**, p. 46

Length of second antennal segment greater than width of head across eyes...........................10

10. Pseudarolia attached only at base of claw, tip free and extending to middle of claw, fig. 43; color green-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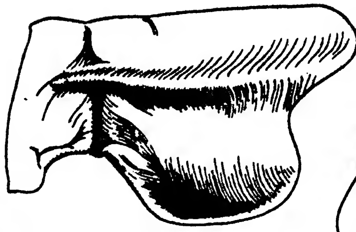
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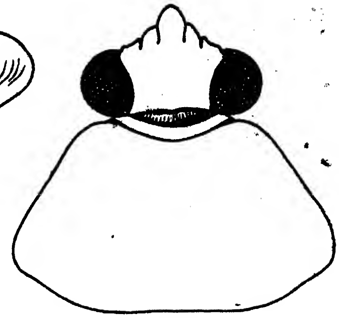
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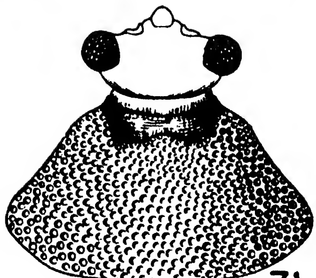
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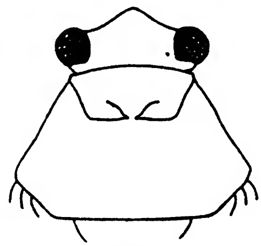
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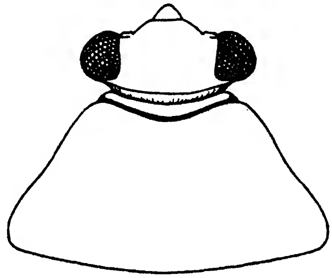
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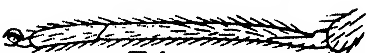
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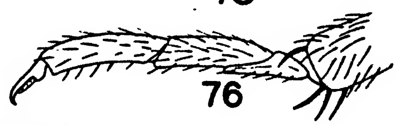
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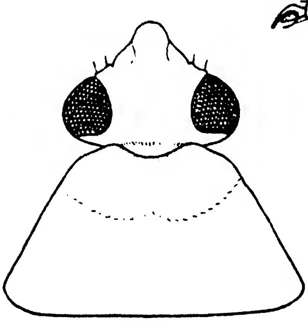
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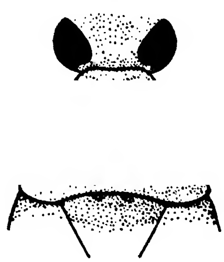
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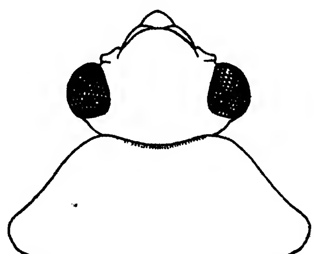
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Fig. 68.—Head and pronotum of *Fulvius brunneus.*

Fig. 69.—Prothorax of *Miris dolabratus,* lateral aspect, showing the prominent lateral ridge characteristic of the Mirinae.

Fig. 70.—Head and pronotum of *Deraeocoris nubilus.*

Fig. 71.—Head and pronotum of *Bothynotus modestus.*

Fig. 72.—Head and pronotum of *Largidea grossa.*

Fig. 73.—Head and pronotum of *Monalocoris filicis.*

Fig. 74.—Tarsi of *Macrolophus tenuicornis.*

Fig. 75.—Tarsi of *Dicyphus vestitus.*

Fig. 76.—Tarsi of *Orectoderus obliquus.*

Fig. 77.—Head and pronotum of *Plagiognathus albifacies.*

Fig. 78.—Pronotal disk of *Orectoderus obliquus,* ♂.

Fig. 79.—Head and pronotum of *Macrotylus amoenus.*

ish yellow, with large, well-marked, dark brown areas................ ....**Reuteroscopus,** p. 48

Pseudarolia united with claw, fig. 39; color dark brown, or yellow with minute, darker markings......... ....**Psallus,** p. 43

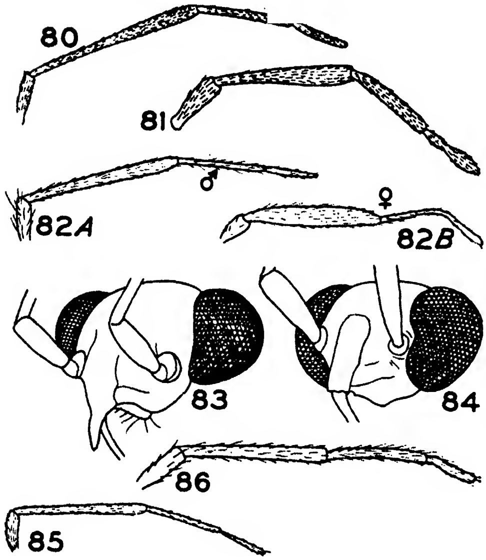


Fig. 80.—Antenna of *Orectoderus obliquus*, ♂.

Fig. 81.—Antenna of *Rhinacloa forticornis*, ♀.

Fig. 82.—Antenna of *Atractotomus magnicornis*. *A*, ♂; *B*, ♀.

Fig. 83.—Head of *Microsynamma bohemanni*, ♂.

Fig. 84.—Head of *Plagiognathus blatchleyi*, ♂.

Fig. 85.—Antenna of *Rhinocapsus vanduzeei*.

Fig. 86.—Antenna of *Microphylellus modestus*.

11. Length of second antennal segment less than width of head across eyes; in species in which the two are almost equal, hind femora not light with numerous dark spots........12

Length of second antennal segment greater than width of head across eyes; in species in which the two are almost equal, hind femora light with numerous dark spots............14

12. Femora light colored, with conspicuous black spots on ventral surface.. ....**Campylomma,** p. 25

Femora dark brown to black or entirely light, without dark spots....13

13. Hemelytra black, with a transverse light mark extending across middle of clavus, fig. 92; male antennae with first and second segments greatly thickened, fig. 92......... ....**Leucopoecila,** p. 50

Hemelytra uniformly dark brown to black, never with a pale mark extending across clavus; male antennae slender, scarcely thicker than in female........**Chlamydatus,** p. 25

14. Pseudarolia large, projecting slightly beyond apices of claws, as in fig. 45; disk of prosternal xyphus depressed, and with elevated margins........15

Pseudarolia minute, not reaching tips of claws, figs. 40, 42; disk of prosternal xyphus convex, margins not elevated.......................16

15. Rostrum not extending beyond hind coxae; head only moderately, obliquely produced......**Lopus,** p. 51

Rostrum extending to middle of venter; head strongly produced anteriorly............**Amblytylus,** p. 51

16. Margin of compound eye well separated from antennal fossa, minimum space between the two more than one-third as great as diameter of antennal fossa; margin of compound eye near antennal fossa almost straight, fig. 83................. ....**Microsynamma,** p. 42

Margin of compound eye almost or quite touching antennal fossa, minimum space between the two not more than one-eighth as great as diameter of antennal fossa; margin of compound eye more or less emarginate near antennal fossa, fig. 84........................17

17. Hind tibiae with dark spines, these spines without dark spots at bases.18

Hind tibiae with light yellow to almost colorless spines, or with dark spines having dark spots at bases........20

18. General color bright yellowish green, with large, well-marked, dark brown areas; pseudarolia attached at base of claw, tip free and extending to middle of claw, fig. 43........... ....**Reuteroscopus,** p. 48

General color dark red, or brown to black; pseudarolia completely united with claw, figs. 38–40......19

19. General color dark red; second anten-

nal segment slightly swollen at apex, so as to become as wide as first segment, fig. 85 .... **Rhinocapsus**, p. 40

General color brown to black; second antennal segment linear, not so wide as first segment, fig. 86 .... **Microphylellus**, p. 40

20. Mesopleuron with flattened, scalelike pubescence .... **Psallus**, p. 43

Mesopleuron always without flattened, scalelike pubescence .... **Plagiognathus**, p. 26

Campylomma Reuter

Campylomma verbasci (Meyer)

Capsus verbasci Meyer (1843, p. 70).

MALE.—Fig. 87. Length 2.50, width 1.10. General color pale testaceous to yellowish, mesoscutum and base of scutellum becoming

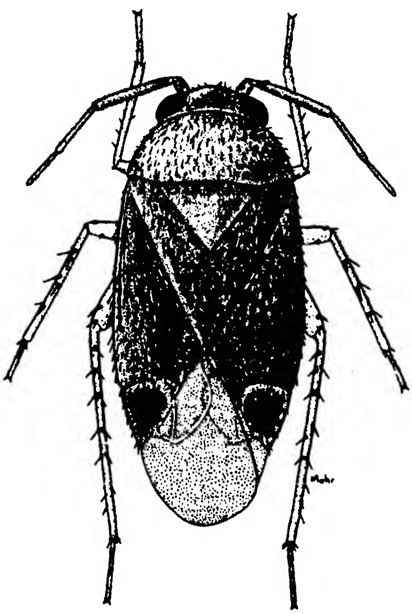


Fig. 87.—*Campylomma verbasci*, ♂.

fulvous, disk of cuneus pale fuscous. Tylus, apical half of first antennal segment and slender area at base of second, large spots on femora and tibiae, black. Body beneath dark brown; clothed with simple, dusky to blackish pubescence. Membrane uniformly pale smoky.

FEMALE.—Length 2.90; width 1.30.

HOST PLANTS.—In Illinois the commonest host is mullein (*Verbascum* sp.). This insect has been taken also on *Verbena stricta* and *Brassica nigra.* It is known to breed occasionally on apple (*Pyrus malus*); sometimes it is attracted to colonies of aphids, where it feeds on their honeydew.

KNOWN DISTRIBUTION.—A common species in the eastern United States and Canada. This species came originally from Europe, but has long been established in North America. It is quite common almost everywhere mullein grows.

Illinois Records.—One hundred seven males and 84 females, taken May 30 to Aug. 1, are from Antioch, Arcola, Bloomington, Delavan, Galena, Kankakee, Monticello, Mount Carroll, Starved Rock State Park, Urbana.

Chlamydatus Curtis

KEY TO SPECIES

1. All femora black, with narrow areas at tips light yellowish; length 2.00–2.30 .... **suavis**, p. 26

Front and middle femora more or less yellow 2

2. Front and middle femora clear yellow, hind femora black with apex yellow; length 2.50 .... **associatus**, p. 25

All femora black with apical one-third yellow .... **pulicarius**, p. 26

Chlamydatus associatus (Uhler)

Agalliastes associatus Uhler (1872, p. 419).

ADULTS.—Length 2.50, width 1.00. Body mostly black. Front and middle legs, hind tibiae and first two segments of all tarsi, yellowish. Third and fourth antennal segments pale fuscous.

FOOD PLANT.—Ragweed (*Ambrosia* sp.).

KNOWN DISTRIBUTION.—Commonly found in the United States and Canada wherever ragweed grows.

Illinois Records.—Ninety-nine males and 86 females, taken May 14 to Nov. 1, are from Algonquin, Allerton, Alton, Amboy, Antioch, Bloomington, Centralia, Champaign, Chicago, Decatur, Delavan, Dubois, Elizabethtown, Galena, Galesburg, Grafton, Grand Detour, Grand Tower, Hardin, Harrisburg, Havana, Herod, Keithsburg, Lawrenceville, Monticello, Murphysboro, Normal, Oak Lawn, Oakwood, Oquawka, Oregon, Quincy, Rockford, Rockton, St. Anne, St. Joseph, Savanna, Springfield,

Starved Rock State Park, Tremont, Urbana, Zion.

Chlamydatus suavis (Reuter)

Agalliastes suavis Reuter (1876, p. 92).

ADULTS.—Length 2.28, width 0.97; slightly smaller than *associatus* (Uhler); entirely black except the tibiae, which are pale yellow.

FOOD PLANT.—Ragweed (*Ambrosia* sp.).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Kansas, New York and southward.

Illinois Records. — Twenty-one males and 35 females, taken June 5 to Sept. 19, are from Algonquin, Alto Pass, Carbondale, Champaign, Darwin, Dixon, Dubois, Elizabeth, Evergreen Park, Fountain Bluff, Freeport, Galesburg, Grand Tower, Havana, Herod, Metropolis, Mount Carmel, Murphysboro, Rockford, Savanna, Starved Rock State Park, Urbana.

Chlamydatus pulicarius (Fallen)

Lygaeus pulicarius Fallen (1807, p. 95).

Not as yet collected in Illinois; known from Michigan, Minnesota, New York.

Plagiognathus Fieber

KEY TO SPECIES

1. Tibial spines pale, without black spots at bases........................ 2
   Tibial spines dark, with a black spot at base of each, these spots sometimes obsolete near apices of tibiae. 3
2. Almost colorless; first antennal segment with two black lines; a black line near apices of dorsal and ventral margins of femora; hind femora with single black spot on anterior aspect ....**nigrolineatus,** p. 34
   Color yellowish, antennae and femora without black lines; hind femora with a few small fuscous points on anterior face.........**sericeus,** p. 34
3. Second antennal segment dark fuscous to black, sometimes slightly paler at middle, but always with more area black than light................ 4
   Second antennal segment chiefly pale, blackish only at base............31
4. Cuneous partly or entirely black, never chiefly brown.............. 5
   Cuneus pale, or uniformly fulvous to dark brown, sometimes dusky at apex, but never distinctly black...20
5. Cuneus more or less pale at base..... 6
   Cuneus uniformly black like corium, rarely somewhat pale at fracture...13
6. Scutellum partly or completely pale, sometimes pale only at apex or along lateral margins............ 7
   Scutellum uniformly black..........10
7. Scutellum black along median line, with variable light-colored areas at margins........................ .....**obscurus** var. **obscurus,** p. 32
   Scutellum pale along median line, sometimes pale only at apex, or almost entirely light colored with only basal angles blackish........ 8
8. Rostrum short, scarcely reaching bases of middle coxae; pronotal disk with broad, dark stripes, leaving median line and lateral margins pale yellow............**gleditsiae,** p. 37
   Rostrum extending to hind coxae.... 9
9. Femora pale to light yellowish brown, hind pair with two rows of prominent black spots, these spots sometimes obscured with darker color; hind femora never noticeably black at base and pale in middle; cuneus pale at base and along outer margin; length 3.90–4.50........... ....**flavoscutellatus,** p. 32
   Femora pale to black, usually black at base and pale in middle; in dark specimens femora black with only apices pale; cuneus pale at base, but not along outer margin; length 3.80–4.00. . **politus** var. **flaveolus,** p. 29
10. Pronotum and hemelytra black; cuneus with a small, light-colored spot at base, or with apex paler than base............................11
    Pronotum pale at posterior margin, corium chiefly light yellowish brown or ivory white, but with a large, somewhat ovate, fuscous spot on apical half; cuneus pale, with a small black spot at apex......... ....**obscurus** var. **fraternus,** p. 32
11. Femora yellowish, with one or two rows of black spots on anterior face, pubescence yellowish to golden; length 4.00.........**cuneatus,** p. 34
    Femora black, pale at apices........12

12. Cuneus pale only on base; pubescence white; length 3.50........................**politus** var. **politus**, p. 29
    Cuneus pale at apex and along outer margin; pubescence yellowish to golden.............**cuneatus**, p. 34
13. Rostrum and legs chiefly yellowish, femora with black spots, or with black spots and lines............14
    Rostrum and legs black or obscured with very dark brown............16
14. Hind femora with black line above and one on ventral margin of apical half, also four or five black spots on anterior aspect....................**annulatus** var. **annulatus**, p. 34
    Hind femora without black lines above and below......................15
15. Length 3.80–4.00; legs orange yellow, hind femora with four or five black spots on antero-dorsal line, a second, less conspicuous row of dots just beneath, and a single spot just below at middle of apical half...........................**negundinis**, p. 33
    Length 3.00; legs yellowish, femora with small, rather inconspicuous, fuscous dots arranged in series on anterior face......**repetitus**, p. 40
16. Femora, tibiae and antennae very dark brown; third antennal segment dusky to fuscous, scarcely paler than second segment; hemelytra very dark brown, somewhat translucent, pubescence yellowish to dusky; length 4.00................................**laricicola**, p. 39
    Femora black except at extreme tips; tibiae pale, with prominent black spots.........................17
17. Length of second antennal segment less than width of head plus width of vertex.......................18
    Length of second antennal segment greater than width of head plus width of vertex.................19
18. Deep black, strongly shining, with white pubescence; length 3.00....................**nigronitens**, p. 30
    Very dark brown, moderately shining, with golden yellow pubescence; length 3.50........**cornicola**, p. 38
19. Rostrum extending to hind coxae; very dark brown, sometimes slightly translucent at cuneal fracture..........................**annulatus** var. **nigrofemoratus**, p. 34
    Rostrum extending only to middle of intermediate coxae; black, cuneus uniformly black like corium.........................**nigritus**, p. 34
20. Rostrum short, not attaining posterior margin of sternum or base of middle coxae; frons with quadrate black spot on either side.............................**gleditsiae**, p. 37
    Rostrum extending to or beyond middle coxae......................21
21. Length of second antennal segment equal to or less than width of pronotum at base.................22
    Length of second antennal segment greater than width of pronotum at base.........................26
22. Rostrum not extending beyond middle coxae...........**brevirostris**, p. 33
    Rostrum extending beyond middle coxae.........................23
23. Femora very dark brown, without definite spots......**cornicola**, p. 38
    Femora with fuscous spots on anterior face, or uniformly pale with spots indistinct or absent.............24
24. Hind femora with two rows of fuscous spots on anterior face; body dull yellowish brown, with lower half of head and under surface of body black..............**fulvidus**, p. 37
    Hind femora with fuscous spots either grouped on distal half, or absent, a dark line forming above; body pale to greenish yellow, ventral surface not darker.....................25
25. Pronotum and hemelytra uniformly light yellowish brown or greenish.....**blatchleyi** var. **blatchleyi**, p. 35
    Basal half of pronotal disk, apical half of corium, and disk of clavus darkened with dark yellowish brown or black............................**blatchleyi** var. **nubilus**, p. 35
26. First antennal segment mostly pale; narrow area at base and two setigerous spots on apical half black.........................**albifacies**, p. 35
    First antennal segment entirely black.27
27. Rostrum not extending beyond middle coxae.........................28
    Rostrum extending beyond middle coxae.........................29
28. Body and wings uniformly straw

colored or slightly tinged with yellow..............**atricornis,** p. 35

Body dark; hemelytra black, basal one-third to one-half of embolium and corium pale, rarely dark; cuneus pale to fulvous, apex frequently dusky; length 4.30–4.70........ ....**brevirostris,** p. 33

29\. Hemelytra without pale areas; general color light yellowish brown; tylus, lora and sternum black..... ....**rosicola,** p. 36

Hemelytra fuscous with pale areas...30

30\. Pale area of corium limited by claval suture; smaller forms, length 3.70–4.60..........................

obscurus var. **albocuneatus,** p. 32

Pale area of corium limited by radial vein; females with fuscous area on apical half of corium divided into two spots by pale stripe which extends along radius and joins that of cuneus; larger forms, length 4.50–4.90...........**alboradialis,** p. 31

31\. Scutellum, and usually entire dorsum as well, black...................32

Scutellum pale or light yellowish brown, sometimes dark brown, frequently the median line blackish, but the basal angles distinctly paler; hemelytra more or less pale, in darkest forms very dark brown, but always somewhat translucent..42

32\. Hemelytra uniformly brownish and translucent; thorax and scutellum black........**suffuscipennis,** p. 40

Hemelytra uniformly black, or blackish with paler areas..............33

33\. Cuneus very light yellow or reddish..34

Cuneus chiefly black...............36

34\. Femora mostly black, only bases and narrow area at tips pale.....**albonotatus** var. **albonotatus,** p. 31

Femora pale or reddish, with two rows of prominent black spots on anterior face; posterior aspect also spotted with black.....................35

35\. Cuneus and femora more or less reddish.....**tinctus** var. **tinctus,** p. 31

Cuneus straw colored or yellowish... ....**tinctus** var. **debilis,** p. 31

36\. Femora pale or fulvous, usually spotted with black..............37

Femora black, pale only at apices....40

37\. First antennal segment mostly pale, black only on base; hind femora pale, a single black spot on lower margin near apex......**davisi,** p. 38

First antennal segment mostly black, small area at apex pale; hind femora with two rows of prominent black spots on anterior face............38

38\. Rostrum not extending beyond middle coxae...........**punctatipes,** p. 39

Rostrum extending beyond middle coxae.........................39

39\. Cuneus pale at base............... ....**dispar** var. **dispar,** p. 39

Cuneus uniformly black............ ....**dispar** var. **crataegi,** p. 39

40\. Length of second antennal segment just equal to width of head across eyes, first and second segments equally thick......**syrticolae,** p. 31

Length of second antennal segment distinctly greater than width of head.........................41

41\. Cuneus pale at base; second antennal segment with basal one-fourth black; body narrower........... ....**pallidicornis,** p. 30

Cuneus uniformly black like corium; second antennal segment with a narrow black area at base, apex dusky; body more ovate, deep black, strongly shining........... ....**flavicornis,** p. 30

42\. Dorsum uniformly greenish yellow, clothed with prominent black pubescence; bases of first and second antennal segments black, a second black annulus present near apex of first segment.............. ....**chrysanthemi,** p. 31

Dorsum darkened or marked with fuscous; pubescence pale; antennae not marked as above............43

43\. Second antennal segment uniformly pale, sometimes with a narrow dusky area at base..............44

Second antennal segment black at base.........................46

44\. First antennal segment pale; dorsum pale, thickly dotted with minute reddish brown or dusky brown spots...........**guttulosus,** p. 40

First antennal segment black; scutellum and cuneus pale; femora with black spots...................45

45\. Scutellum and cuneus pale.......... ....**albatus** var. **albatus,** p. 36

Median line of scutellum and apical half of cuneus blackish.......... .....**albatus** var. **vittiscutis**, p. 36

46. Scutellum uniformly colored, or with median line paler than basal angles.47
Scutellum with median line blackish, darker than lateral areas, which are yellowish or light brown..........50

47. Femora rather uniformly dark except at apices, black spots indistinct; scutellum uniformly colored, usually dark yellowish brown or walnut colored, similar to dorsum........ ....**cornicola**, p. 38
Femora pale or light yellowish brown, with distinct lines of black spots...48

48. Length of rostrum less than width of pronotum; length of second antennal segment only slightly greater than width of head; length 3.30... ....**delicatus**, p. 37
Length of rostrum distinctly greater than basal width of pronotum; length of second antennal segment nearly equal to width of head plus width of vertex; length 4.10......49

49. Calli and two longitudinal stripes on corium black; cuneus black, with margins pale................... ....**salicicola** var. **salicicola**, p. 36
Dorsum uniformly pale, brownish markings only very faintly indicated......................... ....**salicicola** var. **depallens**, p. 36

50. Cuneus uniformly light colored......51
Cuneus brownish or black at apex...52

51. Rostrum scarcely attaining hind margins of middle coxae; propleura clothed only with slender pubescence; femora distinctly spotted with black although these dots at times are slightly obscured at apex. ......**repletus** var. **repletus**, p. 38
Rostrum extending beyond middle coxae; propleura clothed with silky pubescence; femora more or less black on apical half, but black areas scarcely forming distinct spots.... ...**albonotatus** var. **compar**, p. 31

52. Rostrum attaining hind margins of posterior coxae; basal half of corium and more or less broad area on either side of claval suture white; paler areas never brownish, darker areas distinctly black........... ....**similis**, p. 37
Rostrum not attaining hind margins of posterior coxae...............53

53. Hemelytra, except along basal half of radius, dark brown or yellowish brown; most of dorsum dull yellowish brown to tawny, sides of pronotal disk and median line of scutellum dark brown.......**caryae**, p. 38
Hemelytra black, outer half of clavus, basal half of corium and area extending along claval suture to apex pale and translucent............ .....**repletus** var. **apicatus**, p. 38

Plagiognathus politus Uhler

Plagiognathus politus Uhler (1895, p. 52).

MALE.—Length 3.50, width 1.30; ovate, shining black; clothed with simple, pale or white pubescence. Femora dark fuscous to black, apices pale. Rostrum yellowish at middle, apex slightly surpassing hind coxae. Antennae black, tip of first segment pale, third and fourth pale or tinged only with fuscous. Tibiae pale or yellowish, with bases darker, and tibial spines with black spots surrounding their bases.

FEMALE.—Length 3.80, width 1.60; very similar to male but more robust.

Adults appearing after July, apparently of the second brood, are lighter in color, usually having the scutellum and mesal areas of the pronotum straw colored. They do not differ structurally from the typical form and belong to the variety *flaveolus* Knight (1923*d*, p. 434).

FOOD PLANTS.—Ragweed (*Ambrosia* sp.), goldenrod (*Solidago* sp.) and other herbaceous plants, particularly composits; reared from apple (*Pyrus malus*), where the nymphs fed on the tender foliage. In Illinois, specimens have been taken also on hickory (*Carya* sp.), willow (*Salix* sp.), birch (*Betula* sp.), cypress (*Taxodium distichum*), oak (*Quercus* sp.), hazelnut (*Corylus* sp.), red cedar (*Juniperus virginiana*), coralberry (*Symphoricarpos orbiculatus*), locust (*Robinia pseudoacacia*) and pine (*Pinus strobus*).

KNOWN DISTRIBUTION.—Commonly distributed east of the 100th meridian.

Illinois Records.—Four hundred forty-six males and 505 females, taken June 2 to Nov. 1, are from Albion, Algonquin, Allerton, Alton, Alto Pass, Amboy, Anna, Antioch, Beverly Hills, Bloomington, Bluff Springs, Browns, Bureau, Carbondale,

Champaign, Charleston, Chicago, Cypress, Danville, Darwin, Decatur, Delavan, Dolson, Dubois, Eichorn, Elizabethtown, Equality, Forest Park, Fountain Bluff, Fox Lake, Freeport, Galena, Galesburg, Glencoe, Golconda, Grand Detour, Grand Tower, Grandview, Grayville, Hamilton, Hardin, Harrisburg, Havana, Herod, Hillsboro, Homer, Joliet, Jonesboro, Kampsville, Kankakee, Kansas, Kappa, Karnak, Keithsburg, Lawrenceville, Mahomet, Makanda, Marshall, Mason City, McClure, Meredosia, Metropolis, Monticello, Mounds, Mount Carmel, Mount Forest, Muncie, New Milford, Newton, Normal, Oakwood, Oquawka, Oregon, Palos Park, Paxton, Quincy, River Forest, Rockford, Rockton, St. Anne, St. Joseph, Seymour, Shawneetown, Sparland, Springfield, Starved Rock State Park, Ullin, Urbana, Vienna, Volo, Ware, Warren, Warsaw, Waukegan, West Union, White Heath, White Pines Forest State Park, Willow Springs, York, Zion.

Plagiognathus pallidicornis Knight

Plagiognathus politus var. *pallidicornis* Knight (1923*d*, p. 435).

This species is allied to *politus* Uhler, but is easily to be distinguished by its pale antennae and shorter rostrum.

MALE.—Length 3.50, width 1.47. Head width 0.71, vertex 0.37. Antennae, first segment, length 0.24, black; second, 0.91, pale, black at base; third, 0.65, pale; fourth, 0.39, pale. Rostrum, length 1.21, reaching only to middle of hind coxae. General color black, moderately shining, pubescence pale, base of cuneus with a narrow, pale area; ventral margin of propleura, mesoepimera and ostiolar peritremes white.

FEMALE.—Length 3.40, width 1.56; slightly more robust but very similar to male in color and pubescence.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Maine, Massachusetts, Minnesota, New Hampshire, New York, Ontario.

Illinois Records.—ANTIOCH: July 5-7, 1932, Frison *et al.*, 1 ♀; Aug. 1, 1930, Frison, Knight & Ross, 1 ♂, 1 ♀.

Plagiognathus nigronitens Knight

Plagiognathus nigronitens Knight (1923*d*, p. 435).

This species is slightly smaller than *politus* Uhler, with a shorter rostrum; the body is shining black, with the cuneus uniformly black like the corium.

MALE.—Length 3.00, width 1.20. Head width 0.64, vertex 0.33. Rostrum scarcely attaining posterior margin of middle coxae. Antennae, first segment, length 0.22, black; second, 0.78, black, extreme tip pale; third, 0.66, pale; fourth, 0.45, dusky. Pronotum, length 0.53, width at base 1.03. Hemelytral margins very slightly arcuate; uniformly black, shining; cuneus never pale at base; clothed with pale yellowish pubescence. Membrane uniformly pale fuscous, a pale triangular spot bordering cuneus. Legs black, femora light in color at extreme tips; tibiae yellowish, spines with black spots at bases, hind pair becoming infuscated on basal one-third.

FEMALE.—Length 3.00, width 1.30; very slightly more robust than male but very similar in coloration.

FOOD PLANT.—Ragweed (*Ambrosia* sp.), sunflower (*Helianthus* sp.).

KNOWN DISTRIBUTION.—Colorado, Illinois, Michigan, Minnesota, Mississippi, New Jersey, New York, Ohio, Ontario, South Dakota.

Illinois Records.—Eighteen males and 28 females, taken May 12 to Aug. 1, are from Antioch, Champaign, Dubois, Fountain Bluff, Goreville, Grand Tower, Metropolis, Muncie, Oakwood, Vienna, Volo.

Plagiognathus flavicornis Knight

Plagiognathus flavicornis Knight (1923*d*, p. 436).

This is larger and more robust than *nigronitens* Knight and about the same size as *politus* Uhler, but the second antennal segment is pale except for a narrow area at the base; the cuneus remains uniformly black like the corium.

MALE.—Length 3.50, width 1.60. Head width 0.73, vertex 0.38. Rostrum scarcely attaining hind margins of middle coxae. Antennae, first segment, length 0.28, black, apex pale; second, 1.16; third, 0.83, fuscous; fourth, 0.55. Pronotum, length 0.61, width at base 1.16. General color black, shining, including basal margin of cuneus; clothed with yellowish to dusky pubescence. Membrane and veins uniformly dark fuscous. Legs black, tips of femora pale; tibiae pale; knees and spot at base of spines black; spots much reduced or absent on apical one-third.

FEMALE.—Length 3.30, width 1.60; very

similar to male in coloration but more robust in form.

FOOD PLANT.—Sweet gale (*Myrica gale*).

KNOWN DISTRIBUTION.—Illinois, Massachusetts, Minnesota, New York.

Illinois Records.—ANTIOCH: July 5-7, 1932, T. H. Frison, 1 ♂; Aug. 1, 1930, Frison, Knight & Ross, 3 ♂. CEDAR LAKE: Aug. 4, 1906, bog, 3 ♀. SUN LAKE: Aug. 9, 1906, bog, 1 ♀.

Plagiognathus chrysanthemi (Wolff)

Miris chrysanthemi Wolff (1804, p. 157).
Plagiognathus viridulus Reuter (1878, p. 74).

Known only from eastern Canada, New England states, New York, Pennsylvania; Europe. Feeds on the oxeye daisy, *Chrysanthemum leucanthemum*.

Plagiognathus alboradialis Knight

Plagiognathus alboradialis Knight (1923*d*, p. 439).

Known from British Columbia, Connecticut, Maine, Newfoundland, New Hampshire, New York, Ontario, Vermont.

Plagiognathus syrticolae new species

This runs to *flavicornis* Knight in my key (Knight 1923*d*, p. 431), but is distinguished by the shorter and thicker second antennal segment which, in length, just equals the width of the head.

MALE.—Length 3.30, width 1.25. Head width 0.69, vertex 0.34. Rostrum, length 1.08, reaching close to hind margins of hind coxae, dark fuscous, paler at middle. Antennae, first segment, length 0.19, black; second, 0.69, equal in thickness to first, yellowish, black at base, with close, pale pubescence; third, 0.43, yellowish; fourth, 0.31, pale. Pronotum, length 0.52, width at base 1.00. General color black, moderately shining; pubescence pale, with a few fuscous hairs on corium and cuneus. Legs fuscous, tips of femora paler, tibiae pale yellow, spines black, fuscous spots at bases of spines sometimes rather small, tarsi pale, apices fuscous.

FEMALE.—Length 3.60, width 1.50. Head width 0.69, vertex 0.36. Antennae, first segment, length 0.22; second, 0.69, third, 0.43; fourth, 0.30. Very similar to male in form, color and pubescence.

HOST PLANT.—Sand willow (*Salix syrticola*), a willow known only from the shores of the Great Lakes.

Holotype, male.—Waukegan, Ill.: July 6, 1932, on *Salix syrticola*, T. H. Frison *et al.*

Allotype, female.—Same data as for holotype.

Paratypes.—Same data as for holotype, 2 ♂, 18 ♀.

Plagiognathus albonotatus Knight

Plagiognathus albonotatus Knight (1923*d*, p. 437).

This is nearly the same size as *politus* Uhler, but is slightly more robust; the second antennal segment, except for its base, the cuneus, and the basal one-third or more of the corium, are pale.

MALE.—Length 3.50, width 1.50. Head width 0.71, vertex 0.36. Rostrum reaching hind coxae. Antennae, first segment, length 0.28, black; second, 1.00; third, 0.70; fourth, 0.47. Pronotum, length 0.57, width at base 1.11. General color black, basal one-third of embolium and corium, and portion of the adjacent area on clavus, pale; membrane uniformly fuscous; body clothed with pale yellowish pubescence. Legs black; tibiae pale; knees, spines and spot at base of each spine, black; spots absent or much reduced on apical one-third of tibiae.

FEMALE.—Length 3.40, width 1.60. Very similar to male, but slightly more robust. Pronotal disk frequently with pale spot on middle. Sides of venter more or less pale.

Specimens with more extensive pale areas than the typical have been designated *compar* Knight (1923*d*, p. 438); the two have been found to occur together in Illinois.

FOOD PLANT.—Meadow-sweet (*Spiraea salicifolia*).

KNOWN DISTRIBUTION.—Colorado, Illinois, Maine, Minnesota, New York, North Dakota, Ohio.

Illinois Records.—ANTIOCH: July 5-7, 1932, Frison *et al.*, 1 ♂, 1 ♀. NORTHERN ILLINOIS: 1 ♀.

Plagiognathus tinctus Knight

Plagiognathus albonotatus var. *tinctus* Knight (1923*d*, p. 437).

The size and color in this species are suggestive of *albonotatus* Knight, but the pale areas are tinged red.

MALE.—Length 3.70, width 1.50. Head width 0.69, vertex 0.30. Rostrum just reaching hind margins of middle coxae. Antennae,

first segment, length 0.22; second, 0.86, pale, narrow area at base black; third, 0.53, pale; fourth, 0.34. Pronotum, length 0.58, width at base 1.08. Body black; basal one-third of corium and embolium, adjacent area of clavus, cuneus and vertex, pale, but hypodermis tinged reddish; clothed with pale yellowish pubescence. Membranes fuscous, pale on veins and near apex of cuneus. Legs pale to reddish, hind femora with two rows of black X markings.

FEMALE.—Length 3.50, width 1.50; very similar to male in form and coloration.

Paler specimens lacking red in the hypodermis, referable to variety *debilis* Blatchley (1926*b*, p. 941), were taken in company with the typical form.

HOST PLANT.—Sandbar willow (*Salix longifolia*). A single Illinois specimen was taken on red cedar (*Juniperus virginiana*), but probably did not feed on that plant.

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, Ohio, Pennsylvania.

Illinois Records. — GALESBURG: June, 1 ♀. GRAND DETOUR: July 2, 1932, on *Salix* sp., Dozier & Mohr, 4 ♂, 6 ♀. HAVANNA: June 23, 1926, Frison & Hayes, 1 ♂. KAMPSVILLE: June 10, 1932, on *Juniperus virginiana,* H. L. Dozier, 1 ♂. MARSHALL: June 14, 1933, Frison & Ross, 1 ♂, 1 ♀. MONTICELLO: July 19, 1932, on *Salix* sp., T. H. Frison, 1 ♀. PROPHETSTOWN: July 7, 1925, T. H. Frison, 1 ♂. ROCKFORD: July 5, 1932, on *Salix* sp., Dozier & Mohr, 1 ♀. URBANA: Sept. 1, 1930, T. H. Frison, 1 ♂.

Plagiognathus flavoscutellatus Knight

Plagiognathus flavoscutellatus Knight (1923*d*, p. 440).

This may be distinguished by its pale scutellum and fulvous femora with two rows of black spots.

MALE.—Length 4.40, width 1.67. Head width 0.80, vertex 0.36. Rostrum reaching to middle of hind coxae. Antennae black; first segment, length 0.31; second, 1.43; third, 0.88; fourth, 0.47. Pronotum, length 0.68, width at base 1.29. General color black; basal half of embolium and corium, apex of embolium, base and outer margin of cuneus, pale to yellow, pale color on corium limited by radial vein. Membrane uniformly fuscous, spot bordering apex of cuneus and veins pale or yellowish. Legs fulvous to dark brown; femora with two rows of black spots on anterior face, irregularly spotted on posterior face.

FEMALE.—Length 4.30, width 1.70; more robust than male, usually pale areas broader. Scutellum except base, area just before calli, and slight vitta on median line at base of pronotal disk, pale. Embolium, claval suture, anal ridges joining with base of cuneus, pale. Legs more fulvous than in male.

FOOD PLANT.—Sandbar willow (*Salix longifolia*).

KNOWN DISTRIBUTION.—New England states westward to Iowa, Minnesota and Nebraska.

Illinois Records.—Eighteen males and 12 females, taken June 1 to July 8, are from Beardstown, Elizabeth, Freeport, Grand Tower, Mount Carmel, Oakwood, Prophetstown, Thebes, West Union, White Heath.

Plagiognathus obscurus Uhler

Plagiognathus obscurus Uhler (1872, p. 418).

FEMALE.—Fig. 88. Length 4.40, width 1.69; larger and more elongate than *albonotatus* Knight, moderately shining, with pale yellowish pubescence. Rostrum scarcely reaching hind margins of posterior coxae. Antennae fuscous to black, first segment

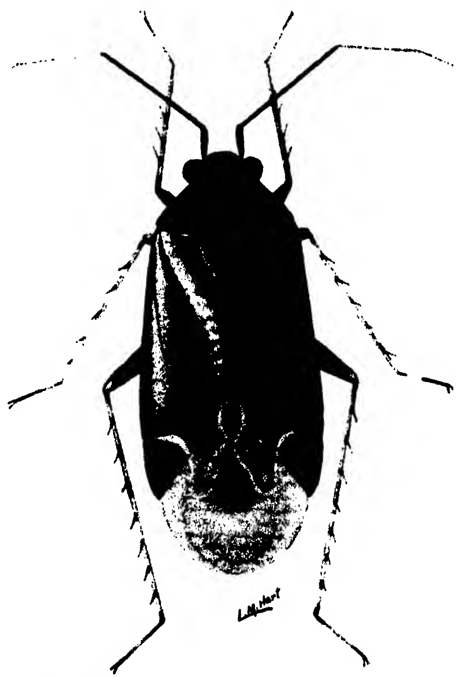


Fig. 88.—*Plagiognathus obscurus.*

pale at extreme apex. Pronotum blackish, calli and central area of disk pale; scutellum black, lateral margins more or less pale; sternum, pleura and ostiolar peritremes black. Hemelytra mostly black; basal one-third of embolium and corium, and adjacent area of clavus, pale; cuneus pale, but apex distinctly blackish. Legs pale to yellowish; base of hind coxae, line on apical half of dorsal margin of femora, and two rows of spots just beneath, black. Venter blackish, more or less pale on sides.

KNOWN DISTRIBUTION.—Colorado, Illinois, Massachusetts, Michigan, Minnesota, New York, Nova Scotia, Quebec.

An extremely light form of this species in which the cuneus is uniformly pale or yellowish, and in which broad, pale areas are sometimes present on the dorsum, is the variety *albocuneatus* Knight (1923*d*, p. 438). Those specimens of this species having the scutellum entirely black may be designated variety *fraternus* Uhler (1895, p. 51). This variety was originally described as a species, but the examination of a large amount of material, from Colorado as well as the eastern states, has led to the conclusion that *fraternus* is nothing more than a variety of *obscurus*. In Illinois material, intergrades occur between all these varietal forms, which are found together in the field.

Illinois Records.—Fifty-four males and 60 females collected June 2 to Sept. 13 are from Algonquin, Antioch, Elizabeth, Fox Lake, Frankfort, Galena, Mason City, Rockton, Rosiclare, Savanna, Starved Rock State Park, Urbana, Volo, Waukegan, Zion.

Plagiognathus negundinis Knight

Plagiognathus negundinis Knight (1929*d*, p. 263).

This species is allied to *annulatus* Uhler, but differs in having a longer second antennal segment which, in the male, equals or slightly exceeds the width of the pronotum at its base.

MALE.—Length 4.00, width 1.36. Head width 0.72, vertex 0.37. Rostrum reaching to middle of hind coxae. Antennae black; first segment, length 0.27; second, 1.20; third, 0.75; fourth, 0.35. Pronotum, length 0.62, width at base 1.17. General color black, vertex pale. Legs orange yellow, hind femora with a row of four or five black spots on antero-dorsal line, also one spot on median line of anterior face at middle of apical half, sometimes with two or three smaller dots, and two subapical black spots beneath; tibiae yellow; knees, spines, and spots at bases of spines, black. Clothed with recumbent, yellowish to dusky brown pubescence.

FEMALE.—Length 3.80, width 1.40; very similar to male in pubescence and coloration.

A variety, *fulvotinctus* Knight (1929*d*, p. 264), is known from Iowa; it differs from the typical *negundinis* in that the embolium, basal half of corium, outer margin of clavus on basal half, and basal half of cuneus are pale to orange yellow

FOOD PLANT.—Box Elder (*Acer negundo*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota.

Illinois Records.—FOX LAKE: June 10, 1936, Ross & Burks, 1 ♂. GALENA: June 30, 1932, Dozier & Mohr, 1 ♂, 1 ♀. HAVANNA: May 31, 1933, C. O. Mohr, 2 ♂, 3 ♀. OQUAWKA: June 13, 1932, H. L. Dozier, 2 ♀. PUTNAM: June 2, 1933, Mohr & Townsend, 2 ♂, 1 ♀. URBANA: June 20, 1932, Frison & Ross, 1 ♀. VOLO: July 8, 1932, Ross, Dozier & Mohr, 1 ♂.

Plagiognathus brevirostris Knight

Plagiognathus brevirostris Knight (1923*d*, p. 441).

The general aspect of this species is very similar to that of *obscurus* var. *albocuneatus* Knight, but it is larger and more elongate and the cuneus usually is tinged with fulvous; it is distinguished by the short rostrum, which does not reach the hind margins of the middle coxae.

MALE.—Length 4.60, width 1.80. Head width 0.79, vertex 0.37. Rostrum reaching middle of intermediate coxae. Antennae, first segment, length 0.35; second, 1.43; third, 1.00; fourth, 0.54. Pronotum, length 0.63, width at base 1.26. General color black, moderately shining, embolium and basal half of corium pale, dark color frequently invading apical half of embolium, sometimes pale color extending along claval suture to anal ridge; cuneus pale, usually tinged with fulvous; apex sometimes dusky. Legs black, femora frequently with rather broad, pale area at base; tibiae pale; knees, spines and spots at base black.

FEMALE.—Length 4.00, width 1.89; shorter and more robust than male; legs with broader pale areas.

KNOWN DISTRIBUTION.—Newfoundland and the New England states, westward to Michigan, Illinois and Minnesota.

Illinois Record.—ANTIOCH: June 10, 1933, Mohr & Townsend, 2 ♂, 3 ♀.

Plagiognathus cuneatus Knight

Plagiognathus annulatus var. *cuneatus* Knight (1923*d*, p. 442).

This form is allied to the typical *annulatus* Uhler, but the cuneus is pale at the base and sometimes at the lateral margin; the femora are yellowish and spotted with black, but the spots do not form black lines.

MALE.—Length 4.00, width 1.50. Head width 0.75, vertex 0.36. Rostrum extending to posterior margins of hind coxae. Antennae black; first segment, 0.30; second, 1.22; third, 0.83; fourth, 0.47. Pronotum, length 0.61, width at base 1.16. General color black; cuneus pale to yellowish at base and lateral margin; clothed with yellowish to golden pubescence. Membrane fuscous. Legs pale to yellow; hind femora with two rows of small fuscous spots on anterior face, sometimes clouded with fuscous.

FEMALE.—Length 4.20, width 1.70; more robust than male but very similar in coloration.

FOOD PLANT.—Wild aster (*Aster* sp.).

KNOWN DISTRIBUTION.—Georgia, Illinois, New Hampshire, New York, Texas, Vermont.

Illinois Record.—ELIZABETHTOWN: May 27-31, 1932, H. L. Dozier, 1 ♂, 1 ♀.

Plagiognathus nigritus Knight

Plagiognathus nigritus Knight (1923*d*, p. 441).

Known only from Colorado, Connecticut, Ohio.

Plagiognathus sericeus (Heidemann)

Psallus sericeus Heidemann (1892, p. 226).
Plagiognathus tiliae Knight (1926*h*, p. 252).

This species is distinguished by its uniformly pale yellow color and by a few small, fuscous points on the anterior face of its hind femora.

MALE.—Length 3.30, width 1.34. Head width 0.74, vertex 0.31. Antennae uniformly yellowish; first segment, length 0.21; second, 1.08; third, 0.51; fourth, 0.31. Pronotum, length 0.57, width at base 1.10. Body uniformly pale yellow, the same color as the *Tilia* blossoms among which the insect retreats; indistinct fuscous points on femora arranged in a double row, tibial spines pale to brownish. Body clothed with soft, recumbent, simple pubescence of pale to golden yellow color.

FEMALE.—Length 3.50, width 1.50. Coloration and pubescence similar to those of male.

HOST PLANT.—Basswood (*Tilia americana*); a single specimen was taken on elm (*Ulmus americana*), but may not have been feeding on that tree.

The adult stage is attained just as the basswood flowers come into full bloom, and the yellow color of the mature bugs matches the color of the flowers perfectly. When disturbed the bugs hide among the petals and are then difficult to see.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Iowa, Minnesota.

Illinois Records.—ANTIOCH: July 5-7, 1932, on *Tilia* sp., T. H. Frison *et al.*, 2 ♂, 3 ♀. KAMPSVILLE: June 10, 1932, on *Tilia* sp., H. L. Dozier, 5 ♂, 2 ♀. MUNCIE: July 22, 1932, Dozier & Park, 1 ♂, 1 ♀. NEW MILFORD: July 3, 1936, Ross & Burks, 1 ♂. URBANA: July 2, 1914, at light, 1 ♀; June 27, 1932, on elm, Frison & Ross, 1 ♀. WAUKEGAN: July 6, 1932, on *Tilia* sp., T. H. Frison *et al.*, 11 ♂, 8 ♀.

Plagiognathus annulatus Uhler

Plagiognathus annulatus Uhler (1895, p. 51)

Neither the typical form of this species nor the variety *nigrofemoratus* Knight (1923*d*, p. 443) has yet been taken in Illinois; known from Colorado, Connecticut Massachusetts, Montana, New York.

Plagiognathus nigrolineatus Knight

Plagiognathus nigrolineatus Knight (1923*d*, p. 443).

This is uniformly pale greenish, with pale pubescence; it may be distinguished by the black lines on the antennae and femora.

MALE.—Length 4.30, width 1.58. Head width 0.75, vertex 0.33. Rostrum reaching to middle of hind coxae. Antennae, first segment, length 0.28, pale, two longitudinal black lines on dorsal surface; second, 1.38, pale, a slender black line on anterior surface extending from base to near middle; third, 0.69, pale; fourth, 0.31. Pronotum, length

0.64, width at base 1.22. General color uniformly pale green, translucent. Legs pale; slender line on dorsal margin of femora, line on apical half of postero-ventral margin of hind femora, and a single dot on anterior face, black.

FEMALE.—Length 4.30, width 1.66; similar to male in coloration.

FOOD PLANT.—Bur oak (*Quercus macrocarpa*).

KNOWN DISTRIBUTION.—Connecticut westward to Minnesota and southward to Texas, its distribution nearly coinciding with the range of its host tree.

Illinois Records. — DUBOIS: May 15, 1916, 1 ♂, 1 ♀; May 22, 1917, 4 ♂, 1 ♀; May 23, 1917, 1 ♂. FRANKFORT: June 8, 1933, Mohr & Townsend, 1 ♀. MONTICELLO: June 11, 1934, Frison & DeLong, 1 ♀. WHITE PINES FOREST STATE PARK: on *Quercus* sp., Dozier & Mohr, 2 ♀.

Plagiognathus albifacies Knight

Plagiognathus albifacies Knight (1927*b*, p 11).

This species is allied to *blatchleyi* Reuter, but is distinguished by its pale first antennal segment, black sternum, longer head and differently formed male genital claspers.

MALE.—Length 4.40, width 1.50. Head width 0.81, vertex 0.35. Rostrum just reaching posterior margins of hind coxae. Antennae, first segment, length 0.39; second, 1.55; third, 1.14; fourth, 0.58. Pronotum, length 0.74, width at base 1.28. Hemelytra pale yellow, inner half of clavus and apical half of corium dusky to pale fuscous; cuneus pale to dusky, translucent. Legs pale, femora with two rows of black spots on anterior face, hind femora with antero-dorsal row composed of six larger black spots. Genital claspers distinctive, the left clasper with lateral or basal lobe much larger than in *blatchleyi*.

FEMALE.—Length 4.70, width 1.68. Very similar to male in coloration and pubescence.

FOOD PLANT.—Leafcup (*Polymnia canadensis*).

KNOWN DISTRIBUTION.—Illinois, Indiana, Maryland.

Illinois Records.—ALDRIDGE: May 8, 1932, H. L. Dozier, 1 ♀. BLOOMINGTON: July 18, 1932, T. H. Frison, 7 ♂, 1 ♀. DANVILLE: Aug. 17, 1934, DeLong & Ross, 2 ♀. GOLCONDA: July 25, 1930, on *Polymnia canadensis*, Knight & Ross, 48 ♂, 68 ♀. HARDIN: June 5-9, 1932, H. L. Dozier, 11 ♂, 13 ♀. KARNAK: June 23, 1932, Ross, Dozier & Park, 1 ♀. URBANA: 1930, on *Polymnia* sp., T. H. Frison, 2 ♂, 6 ♀; Aug. 25, 1930, H. H. Knight, 8 ♂, 1 ♀.

Plagiognathus atricornis Knight

Plagiognathus atricornis Knight (1926*a*, p. 9).

This species is distinguished by its pale color, pale pubescence and black antennae.

MALE.—Length 3.50, width 1.20. Head width 0.77, vertex 0.27. Eyes prominent, black. Rostrum just attaining posterior margins of middle coxae. Antennae uniformly black; first segment, length 0.24; second, 1.07; third, 0.66; fourth, 0.34. Pronotum, length 0.54, width at base 1.03. General color pale greenish testaceous, pronotum distinctly green, calli yellowish; hemelytra somewhat translucent, membrane and veins uniformly pale fumate. Legs pale, hind femora with a double row of prominent black spots; knees, tibial spines, and large spots at base of spines, black.

FEMALE.—Length 3.40, width 1.34. Form and coloration similar to those of male.

HOST PLANT.—Specimens were taken in Illinois on red birch (*Betula nigra*).

KNOWN DISTRIBUTION.—Previously known only from Pennsylvania.

Illinois Record.—HARRISBURG: June 25, 1932, on *Betula nigra*, Ross, Dozier & Park, 2 ♂, 1 ♀.

Plagiognathus blatchleyi Reuter

Plagiognathus blatchleyi Reuter (1912*a*, p. 61).

MALE.—Length 4.60, width 1.70; pale greenish and yellowish brown; clothed with pale yellowish pubescence, hairs becoming dusky on cuneus and apical half of corium and embolium. Antennae black, third and fourth segments pale fuscous, extreme apex of first and second segments pale. Tylus black. Basal and apical segments of rostrum almost black. Legs nearly as in *chrysanthemi* (Wolff) but black spots on femora less conspicuous. Membrane fuscous, central area of apical half, veins and area invading each side, paler.

FEMALE.—Length 4.40, width 1.70; very similar to male in coloration, although membrane, and sometimes antennae, slightly paler.

All but one or two of the Illinois specimens are darker than the typical form, with a brown band developed across the basal half of the pronotum and the apical half of the clavus. These belong to the variety *nubilus* Knight (1923*d*, p. 444).

FOOD PLANT.—Several specimens were taken in Illinois on ragweed (*Ambrosia* sp.).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Maine, Maryland, Massachusetts, New Jersey, New York, Ohio, Virginia.

Illinois Records.—Nineteen males and 19 females, taken Aug. 10 to Oct. 6, are from Algonquin, Carbondale, Charleston, Elizabethtown, Havana, Jonesboro, Mounds, Oakwood, Rockford, Sparland, Urbana.

Plagiognathus salicicola Knight

Plagiognathus salicicola Knight (1929*b*, p. 69).

This species is suggestive of *delicatus* (Uhler) but is easily distinguished by its larger size and black markings; the cuneus is black with pale margins.

MALE.—Length 4.10, width 1.50. Head width 0.83, vertex 0.33. Rostrum extending to middle of hind coxae. Antennae, first segment, length 0.27; second, 1.09, pale, base and apex black; third, 0.77; fourth, 0.45. Pronotum, length 0.65, width at base 1.26. Clothed with pale to yellowish simple pubescence. General color black; anterior margin of pronotum, disk behind calli, lower half of propleura, scutellum except at base, areas along claval suture and radial vein, embolium, all margins of cuneus, sides of sternum, epimera, and apical area of genital segment, pale to yellowish. Legs pale, with two rows of spots on femora; apex of inner face of femora, knees, spots and spines on tibiae, black.

FEMALE.—Length 3.90, width 1.70; very similar to male in pubescence and coloration, but with pale areas on dorsum broader.

The fuscous markings on the dorsum vary considerably in intensity and size; the extremely light form, in which these markings are very indistinct, is referable to the variety *depallens* Knight (1929*b*, p. 70).

FOOD PLANT.—Sandbar willow (*Salix longifolia*).

KNOWN DISTRIBUTION.—Illinois, Indiana, Iowa, Minnesota.

Illinois Records.—ALTON: July 19-21, 1932, on *Salix* sp., Ross & Dozier, 2 ♀. ANNA: June 6, 1884, 1 ♀. SAVANNA: July 23, 1892, on sandbar in Mississippi River, McElfresh, Hart & Forbes, 5 ♀; July 25, 1892, from sandy island in Mississippi River, McElfresh, Hart, Shiga & Forbes, 1 ♂, 5 ♀; July 26, 1892, along railroad in bottomlands, McElfresh, Hart & Forbes, 1 ♀; July 27, 1892, at light and sugar, McElfresh, Shiga, Forbes & Hart, 1 ♂, 1 ♀; Aug. 1, 1892, from willow, F. M. McElfresh, 1 ♂. WEST UNION: June 26, 1932, on *Salix* sp., Ross, Dozier & Park, 2 ♂.

Plagiognathus rosicola Knight

Plagiognathus rosicola Knight (1923*d*, p. 446).

This species is fulvo-testaceous, with the antennae, tylus, sternum, and prominent spots on the femora, black; the rostrum reaches to the middle of the venter.

MALE.—Length 4.30, width 1.64. Head width 0.75, vertex 0.33. Antennae black; first segment, length 0.31; second, 1.42; third, 1.00; fourth, 0.44. Pronotum, length 0.66, width at base, 1.22. Color fulvo-testaceous to fusco-brownish, clothed with yellowish or golden pubescence; scutellum slightly darker than pronotum, disk of cuneus darker. Legs pale yellow and tinged with brown, femora with two rows of very prominent black spots on anterior face; tibiae with large and prominent black spots at base of spines.

FEMALE.—Length 4.40, width 1.70; more robust than male, but very similar in coloration.

FOOD PLANT.—Wild rose (*Rosa* sp.).

KNOWN DISTRIBUTION.—Illinois, Kansas, Maryland, Missouri.

Illinois Record.—MONTICELLO: July 19, 1932, T. H. Frison, 1 ♂.

Plagiognathus albatus (Van Duzee)

Psallus albatus Van Duzee (1915, p. 116).

ADULTS.—Length 4.20, width 1.40. General color whitish. Tylus, basal segment of antennae, more or less broad area at lateral margins of pronotal disk, inner half of clavus, subapical spot on corium or, in darker specimens, spot covering apical half of corium, sternum and venter, black. Calli and second antennal segment frequently yellowish. Membrane pale, a distinct fus-

cous ray along margin just beyond clear spot at tip of cuneus. Hind femora with a group of black spots on apical half, sometimes with a subdorsal row of spots extending over basal half. Tibiae with small and sometimes indistinct spots at bases of spines; female with pale areas broader than those of male.

The variety *vittiscutis* Knight (1923*d*, p. 445) differs from the typical in having the apical half of the cuneus black; it has not yet been collected in Illinois. It occurs on butternut (*Juglans cinerea*).

FOOD PLANT.—Sycamore (*Platanus occidentalis*); specimens were also taken on walnut (*Juglans nigra*).

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Georgia, Illinois, Iowa, Massachusetts, Michigan, Minnesota, New York, Ohio, Pennsylvania, Quebec.

Illinois Records.—Forty-seven males and 49 females, taken June 13 to Aug. 9, are from Alton, Ashley, Danville, Dolson, Eichorn, Herod, Kansas, Monticello, Oakwood, Putnam, Rockford, Urbana, Vienna.

Plagiognathus similis Knight

Plagiognathus albatus var. *similis* Knight (1923*d*, p. 445).

The coloration of this form is suggestive of *albatus* (Van Duzee), but it may be distinguished by the black base of its second antennal segment and the two rows of black spots on the hind femora.

MALE.—Length 3.90, width 1.38. Head width 0.78, vertex 0.30. Rostrum extending almost to hind margin of posterior coxae. Antennae, first segment, length 0.23; second, 1.08; third, 0.72; fourth, 0.43. Pronotum, length 0.62, width at base 1.14. General color black, varied with pale; scutellum pale, with a rather broad, black, median line; hemelytra pale, inner half of clavus, apical half of corium and area invading embolium, black; cuneus pale, translucent, apical half black. Legs pale yellow; hind femora with two rows of black spots, anterior pairs with three or four spots forming a line; tibial spines black with prominent black spot around base of each.

FEMALE.—Length 3.50, width 1.50; very similar to male in form and coloration.

FOOD PLANT.—Red birch (*Betula nigra*). Taken also on alder (*Alnus*) in Michigan and on birch in Maryland.

Illinois Records.—EICHORN: June 24, 1932, Hicks Branch, on *Betula nigra*, Ross, Dozier & Park, 1 ♂. GALENA: June 30, 1932, on *Betula nigra*, Dozier & Mohr, 2 ♂, 3 ♀. HARRISBURG: June 25, 1932, on *Betula nigra*, Ross, Dozier & Park, 20 ♂, 24 ♀; June 15, 1934, DeLong & Ross, 1 ♀.

Plagiognathus fulvidus Knight

Plagiognathus fulvidus Knight (1923*d*, p. 447).

Known from Connecticut, Maryland, New Jersey, North Carolina, Ohio.

Plagiognathus delicatus (Uhler)

Psallus delicatus Uhler (1887*b*, p. 34).

ADULTS.—Length 3.30, width 1.40. General color reddish yellow to brownish. First antennal segment except extreme tip, and a ring at base of second segment, dark fuscous; front of head more or less dark either side of median line. Hemelytra, sternum and abdomen shaded with fuscous, sometimes basal margins of calli quite dark; scutellum yellowish, usually with basal angles dark, thus leaving a median pale line; membrane lightly shaded with fuscous; cuneus with area near middle and spot on either side adjacent to apex clear. Legs pale yellow to fulvous, with two rows of spots on femora; tibial spines and spots around their bases, and apex of tarsi and claws, black.

HOST PLANT.—Honey locust (*Gleditsia triacanthos*).

KNOWN DISTRIBUTION.—Illinois, Indiana, Iowa, Missouri, New York, Ohio, Pennsylvania, Virginia.

Illinois Records.—ELIZABETHTOWN: May 27-31 1932, H L. Dozier, 1 ♂, 9 ♀. GRAND TOWER: May 12, 1932, Frison, Ross & Mohr, 18 ♂, 11 ♀. URBANA: June 7, 1916, on tree trunk, 1 ♀; June 9, 1916, on tree trunk, 1 ♀; June 27, 1917, on tree trunk, 7 ♀; June 1, 1933, H. H. Ross, 1 ♀.

Plagiognathus gleditsiae Knight

Plagiognathus gleditsiae Knight (1929*d*, p. 265).

This species is allied to *delicatus* (Uhler), but is distinguished by its broader head and shorter rostrum; the scutellum is black with a median pale line, and the frons has a quadrate black spot on either side of the median line.

MALE.—Length 3.00, width 1.17. Head

width 0.69, vertex 0.34. Rostrum reaching only to middle of sternum. Antennae dark fuscous to black; first segment, length 0.17; second, 0.78, third, 0.39; fourth, 0.22. Pronotum, length 0.52, width at base 1.04. General color dark fuscous to black; vertex, median line of frons, median line and lateral margins of pronotal disk, claval suture, and base of cuneus, straw colored to yellowish. Legs straw colored to yellowish, femora dusky but with small, darker spots showing through; tibial spines and spots around their bases black. Body clothed with fine, short, pale to dusky pubescence.

FEMALE.—Length 3.00, width 1.29. Rather similar to male in form and pubescence, but color much paler; pronotum yellowish with only calli black; frons with quadrate black spot on either side; median line of scutellum pale; hemelytra pale yellowish with fuscous confined to inner angles of clavus and apical half of corium, and with cuneus uniformly pale.

FOOD PLANT.—Honey locust (*Gleditsia triacanthos*).

KNOWN DISTRIBUTION.—Illinois and Texas.

Illinois Records.—DOLSON: June 25, 1932, Rocky Branch, Frison & Mohr, 1 ♀. FOUNTAIN BLUFF: May 15, 1932, Frison, Ross & Mohr, 1 ♂. GRAND TOWER: May 12, 1932, Frison, Ross & Mohr, 5 ♀; May 12, 1932, H. L. Dozier, 1 ♂. MAKANDA: Giant City State Park, May 21, 1932, H. L. Dozier, 1 ♀.

Plagiognathus caryae Knight

Plagiognathus caryae Knight (1923*d*, p. 448).

Occurs on hickory (*Carya ovata*) and pecan (*C. illinoensis*). Not yet taken in Illinois; known from Mississippi, New York and Texas.

Plagiognathus repletus Knight

Plagiognathus repletus Knight (1923*d*, p. 449).

This species is suggestive of *albatus* var. *vittiscutis* Knight but has the rostrum distinctly shorter.

MALE.—Length 3.70, width 1.25. Head width 0.69, vertex 0.30. Rostrum extending only to middle of intermediate coxae. Antennae, first segment, length 0.26; second, 1.10 third, 0.69; fourth, 0.34. Pronotum, length 0.56, width at base 1.10; black; area occupying center of disk and extending between calli, pale yellowish. Scutellum yellowish; median line black. Hemelytra black; basal one-third of corium, embolium and cuneus, yellowish, translucent; membrane fuscous, veins paler. Clothed with simple yellowish pubescence. Legs yellowish; hind femora brownish on apical half except at extreme apex; two rows of black spots on anterior face; front and middle femora showing only three or four spots.

FEMALE.—Length 3.90, width 1.40; more robust than male and rather similar in coloration, but frequently with the pale areas broader. Very pale specimens may fail to show dark line on scutellum.

The variety *apicatus* Knight (1923*d*, p. 449) is generally darker on the dorsum than is the typical form; *repletus apicatus* has not been collected in Illinois.

FOOD PLANTS.—Walnut (*Juglans nigra*) and butternut (*Juglans cinerea*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, New York, Ohio.

Illinois Records.—Nineteen males and 36 females, taken June 5 to July 17, are from Alton, Freeport, Galena, Galesburg, Grand Detour, Hardin, Harvard, Marshall, Monticello, Palos Park.

Plagiognathus davisi Knight

Plagiognathus davisi Knight (1923*d*, p. 452).

Known from Iowa and New York, but not yet taken in Illinois.

Plagiognathus cornicola Knight

Plagiognathus cornicola Knight (1923*d*, p. 450).

The general coloration of this species is fusco-brownish or ligneous with the calli darker; the second antennal segment is fusco-brownish and black at the base.

MALE.—Length 3.40, width 1.24. Head width 0.69, vertex 0.32. Rostrum reaching near hind margin of middle coxae. Antennae, first segment, length 0.21; second, 0.82; fusco-brownish to fuscous, black at base; third, 0.60; fourth, 0.34. Pronotum, length 0.54, width at base 1.10. General color fusco-brownish or ligneous, somewhat translucent on hemelytra; cuneus evenly colored like corium; membrane fuscous, veins pale brownish. Body clothed with yellowish to golden pubescence. Legs fusco-brownish to black; tip of femora pale; tibial spines with

prominent black spots around the base of each.

FEMALE.—Length 3.10, width 1.33; slightly more robust than male, but very similar in coloration.

FOOD PLANTS.—Dogwoods (*Cornus amomum* and *C. stricta*).

KNOWN DISTRIBUTION—Illinois, Massachusetts, New York, Virginia.

Illinois Records.—FRANKFORT: June 8, 1933, Mohr & Townsend, 1 ♂, 1 ♀. ST. JOSEPH: June 17, 1932, T. H. Frison, 1 ♂. URBANA: June 20, 1932, T. H. Frison, 4 ♂, 3 ♀.

Plagiognathus laricicola Knight

Plagiognathus laricicola Knight (1923*d*, p. 452).

This species is black, with fuscous legs; small black spots show through the obscuration on the legs; the body is clothed with yellowish and dusky pubescence.

MALE.—Length 3.90, width 1.40. Head width 0.66, vertex 0.33. Rostrum reaching to middle of hind coxae. Antennae, first segment, length 0.27; second, 1.03, fusco-brownish with black at base; third, 0.66; fourth, 0.36. Pronotum, length 0.55, width at base 1.11. Body fuscous black; base of cuneus scarcely paler than corium. Legs dark fuscous; small black dots visible on anterior and posterior faces of femora; tibiae fuscous, but black setigerous spots showing through infuscation.

FEMALE.—Length 3.60, width 1.55; more ovate and robust than male, but very similar in coloration.

FOOD PLANT.—Larch (*Larix laricina*).

KNOWN DISTRIBUTION.—Canada, Illinois, Maine, Minnesota, New York.

Illinois Records.—ANTIOCH: July 5-7, 1932, on *Larix*, Frison *et al.*, 44 ♂, 78 ♀. GRAND DETOUR: July 2, 1932, Dozier & Mohr, 1 ♀.

Plagiognathus punctatipes Knight

Plagiognathus punctatipes Knight (1923*d*, p. 450).

This species is black, with the second antennal segment black at base, pale beyond; the legs are yellowish, and the hind femora have two rows of black spots on each anterior face.

MALE.—Length 3.80, width 1.70. Head width 0.72, vertex 0.37. Rostrum reaching middle of hind coxae. Antennae, first segment, length 0.25; second, 0.97; third, 0.66; fourth, 0.39. Pronotum, length 0.67, width at base 1.28. Body black, moderately shining, clothed with pale yellowish pubescence; cuneus uniformly black, scarcely translucent at base. Legs pale yellowish to fulvous; hind femora with two rows of prominent black spots on anterior faces; tibial spines with rather small black spots around bases.

FEMALE.—Length 3.70, width 1.70; slightly more robust than male, but very similar in coloration.

FOOD PLANT.—Black walnut (*Juglans nigra*). A single Illinois specimen was taken on apple.

KNOWN DISTRIBUTION.—Illinois, Michigan, New York, Ohio, Ontario, Pennsylvania.

Illinois Records.—Twenty-six males and 28 females, taken May 27 to July 6, are from Elizabethtown, Freeport, Galena, Hardin, Kampsville, Keithsburg, Urbana, Warsaw, White Heath, White Pines Forest State Park, Zion.

Plagiognathus dispar Knight

Plagiognathus punctatipes var. *dispar* Knight (1923*d*, p. 451).

This species is smaller and more slender than *punctatipes* Knight; the two are very similar in coloration, but *dispar* has a narrow, pale area at base of cuneus. This species was originally described as a variety of *punctatipes* Knight, but more recent examination of the genital characters reveals a distinct difference in structure of the left genital clasper.

MALE.—Length 3.50, width 1.28. Head width 0.67, vertex 0.31. Rostrum reaching middle of hind coxae. Antennae, first segment, length 0.22; second, 0.90, yellow with narrow black area at base; third, 0.58; fourth, 0.36. Pronotum, length 0.53, width at base 1.06. Body black, moderately shining; base of cuneus yellowish, translucent. Legs straw colored to yellow; hind femora with two rows of fuscous spots on anterior face and a group of five or six spots on posterior surface near apex; tibiae with very small fuscous spots around base of spines.

FEMALE.—Length 3.30, width 1.39; slightly more robust than male but very similar in coloration.

The cuneus varies considerably in color; specimens in which it tends to be entirely,

rather than partly, black belong to the variety *crataegi* Knight (1929*d*, p. 264).

FOOD PLANTS.—Hickory (*Carya* sp.), hawthorn (*Crataegus* sp.); Illinois specimens were taken also on ash (*Fraxinus* sp.).

KNOWN DISTRIBUTION. — Illinois, Iowa, Michigan, New England, New York.

Illinois Records.—Sixty-three males and 67 females, taken May 31 to July 4, are from Champaign, Dixon, Frankfort, Havana, Joliet, Lacon, Sparland, Urbana, White Pines Forest State Park.

Plagiognathus suffuscipennis Knight

Plagiognathus suffuscipennis Knight (1923*d*, p. 454).

This species is distinguished by its translucent, pale yellowish brown hemelytra; the second antennal segment is pale yellowish brown, darker at the base.

MALE.—Length 3.40, width 1.30. Head width 0.68, vertex 0.36. Rostrum reaching hind coxae. Antennae, first segment, length 0.23; second, 0.81; third, 0.54; fourth, 0.36. Pronotum, length 0.45, width at base 0.98. Body blackish brown; pubescence yellowish to dusky; scutellum black; cuneus uniformly translucent yellowish brown like corium. Legs yellowish testaceous; femora with two series of fuscous dots on anterior face and a group of six or eight spots on apical half of posterior face.

FEMALE.—Length 3.20, width 1.37; very similar to male in coloration, but more robust in form.

FOOD PLANT.—Spruce (*Picea mariana*).

KNOWN DISTRIBUTION.—Illinois, Maine, Minnesota, New York.

Illinois Records.—ANTIOCH: July 5-7, 1932, Frison *et al.*, 1 ♀. GALENA: June 30, 1932, on spruce, Dozier & Mohr, 10 ♂, 8 ♀. KEITHSBURG: June 15, 1932, on spruce, H. L. Dozier, 6 ♂, 8 ♀.

Plagiognathus guttulosus (Reuter)

Psallus guttulosus Reuter (1876, p. 89).

This species is distinguished by its pale color and its numerous reddish brown dots. It has been placed in the genus *Psallus* up to the present time, but the possession of a single type of simple pubescence refers it to *Plagiognathus*.

MALE.—Length 3.00, width 1.20. Head width 0.69, vertex 0.30. Rostrum reaching posterior margins of hind coxae. Antennae, first segment, length 0.21; second, 0.99; thickness equal to that of first segment; third, 0.34; fourth, 0.26. Pronotum, length 0.52, width at base 0.99. Body pale, thickly dotted with reddish brown to dusky brown points; calli shaded brown; median line of pronotal disk paler. Body clothed with pale to yellowish simple pubescence. Legs pale; femora thickly dotted with brown, hind pair darker; tibial spines pale, but with black dot around base of each.

FEMALE.—Length 3.00, width 1.40; very similar to male in color and pubescence.

FOOD PLANT.—Oak (*Quercus* sp.)

KNOWN DISTRIBUTION. — Florida, Illinois, Mississippi, Texas.

Illinois Records.—CHAMPAIGN: June 6, 1888, at electric light, 1 ♂. DUBOIS: May 21, 1917, 1 ♂; May 22, 1917, 5 ♀.

Plagiognathus repetitus Knight

Plagiognathus repetitus Knight (1923*d*, p. 453).

Breeds on cranberry (*Vaccinium*) in Massachusetts. Not yet collected in Illinois, but occurs in Massachusetts, Michigan, New Jersey, New York.

Rhinocapsus Uhler

No Illinois species; *Rhinocapsus vanduzeei* Uhler occurs from New England west to Michigan and south to North Carolina.

Microphylellus Reuter

KEY TO SPECIES

1. Hemelytra more or less pale; embolium, cuneus and basal half of corium almost colorless or yellowish; scutellum light, with median line black 2
   Hemelytra uniformly blackish...... 3
2. Second antennal segment and femora uniformly pale............**maculipennis** var. **maculipennis,** p. 41
   Second antennal segment dark brown to black, femora with fuscous dots. ....**maculipennis** var. **fuscicornis,** p. 41
3. Second antennal segment black, first segment pale on apical half....... ....**nigricornis,** p. 41
   Second antennal segment pale, or fuscous at base only............. 4

4. Length of second antennal segment less than width of pronotum at base 5
   Length of second antennal segment equal to or greater than width of pronotum at base 7
5. First antennal segment yellowish, fuscous at base only; femora usually with fuscous dots on anterior face although these at times absent; length 3.30 . . . . **modestus**, p. 41
   First antennal segment black, or mostly black 6
6. Smaller, length 2.60–2.80; rostrum not extending beyond hind margins of middle coxae . . . . **tsugae**, p. 42
   Larger, length 3.30; rostrum nearly attaining hind margins of posterior coxae . . . . **tumidifrons**, p. 42
7. Rostrum long, extending beyond hind coxae, reaching to near middle of venter; hind femora uniformly pale yellowish . . . . **longirostris**, p. 42
   Rostrum shorter, reaching only to middle of hind coxae; hind femora with fuscous spots on anterior face. . . . . **elongatus**, p. 42

Microphylellus modestus Reuter

Microphylellus modestus Reuter (1912*a*, p. 62).

ADULTS.—Length 3.30–3.50, width 1.30. Body ligneous black. Antennae and legs yellowish; first antennal segment fuscous at base, dark area sometimes extended from base toward middle. Hind femora usually with three or four fuscous dots near dorsal margin on anterior face, although these spots are frequently indistinct. Hemelytra mostly black, with membrane fuscous; apex of cuneus slightly paler, and veins pale fuscous.

HOST PLANTS.—Elm (*Ulmus*) and white oak (*Quercus alba*). In Illinois, specimens have been taken also on hazelnut (*Corylus americana*), hawthorn (*Crataegus mollis*) and hickory (*Carya* sp.). On elm the bugs are found most frequently among leaves curled by aphids, where they feed to some extent on honeydew. I have observed this species feeding on eggs of the elm leaf beetle, *Galerucella luteola* Mullsant.

KNOWN DISTRIBUTION. — From Minnesota to Texas and in all states eastward.

Illinois Records.—Fifty-one males and 57 females, taken May 23 to July 6, are from Algonquin, Dolson, Elizabethtown, Frankfort, Freeport, Galena, Galesburg, Grand Detour, Hardin, Havana, Homer, Keithsburg, Maywood, Meredosia, Monticello, Mounds, Rockford, Rogers, Savanna, Ullin, Urbana, Waukegan, White Heath, White Pines Forest State Park, Willow Springs, Zion.

Microphylellus nigricornis Knight

Microphylellus nigricornis Knight (1923*d*, p. 457).

Not yet collected in Illinois; known to occur in Minnesota, New York, Ontario. It breeds on aster (*Aster macrophyllus*).

Microphylellus maculipennis Knight

Microphylellus maculipennis Knight (1923*d*, p. 456).

This is similar in size to *modestus* Reuter, but is distinguished by having pale markings on the dorsum.

MALE.—Length 3.40, width 1.30. Head black, width 0.69; vertex pale, 0.33. Rostrum yellowish, dark at base and apex and reaching hind margins of middle coxae. Antennae, first segment, length 0.30, yellow, fuscous at base; second, 0.86, yellow, fuscous at base and dusky at apex; third, 0.47, yellowish with dusky tinge; fourth, 0.33, pale fuscous. Pronotum, length 0.55, width at base 1.11; black, moderately shining; central area of disk and basal angles pale to yellowish; clothed with fine, yellowish pubescence. Scutellum pale yellowish; rather broad median line of scutellum and mesoscutum black. Hemelytra mostly black, with embolium, cuneus, and basal half of corium, usually straw colored to yellow but sometimes distinctly reddish; membrane fuscous, paler bordering apex of cuneus, veins pale only at apex of areoles. Legs pale to yellowish; basal half of hind coxae and tips of tarsi fuscous.

FEMALE.—Length 3.40, width 1.39; slightly more robust than male but very similar in coloration.

A form of this species having the antennae very dark, almost black, rather than light is known only from Maine; it has been described as *maculipennis fuscicornis* Knight (1923*d*, p. 457).

FOOD PLANT. — White oak (*Quercus alba*).

KNOWN DISTRIBUTION. — Illinois, Iowa, Maine, Minnesota, Texas.

Illinois Records.—FRANKFORT: June 8,

1933, Mohr & Townsend, 1 ♀. KEITHSBURG: June 8, 1932, Ross & Mohr, 1 ♂. MOUNDS: May 23, 1932, H. L. Dozier, 6 ♀. URBANA: May 28, 1934, Crystal Lake Park, Ross & Mohr, 1 ♂. WHITE HEATH: May 29, 1933, H. H. Ross, 1 ♂.

Microphylellus tsugae Knight

Microphylellus tsugae Knight (1923*d*, p. 456).

Known only from New York; breeds on hemlock (*Tsuga canadensis*).

Microphylellus elongatus Knight

Microphylellus elongatus Knight (1923*d*, p. 458).

This species is larger and longer than *modestus* Reuter; the length of the second antennal segment is equal to the width of the pronotum at its base.

MALE.—Length 4.00, width 1.44. Head width 0.68; vertex 0.33; head black, slightly paler at base of vertex. Rostrum reaching to middle of hind coxae. Antennae, first segment, length 0.28, yellowish, fuscous at base; second, 1.19, yellow, sometimes slightly dusky at base; third, 0.77, yellowish; fourth, 0.33, yellowish. Pronotum, length 0.62, width at base 1.16; black, pubescence pale to dusky. Scutellum, sternum and pleura black. Hemelytra black, strongly shining; emboliar margins nearly straight; pubescence pale to dusky. Legs straw colored to yellow; bases of hind and middle coxae, and tips of tarsi, black; hind femora with a row of fuscous spots on anterior face near dorsal margin. Venter black, shining.

FEMALE.—Length 3.80, width 1.40; very similar to male.

FOOD PLANT.—Sugar maple (*Acer saccharum*).

KNOWN DISTRIBUTION.—Illinois, Minnesota, New York.

Illinois Record.—ZION: July 6, 1932, Frison *et al.*, 1 ♂, 1 ♀.

Microphylellus longirostris Knight

Microphylellus longirostris Knight (1923*d*, p. 458).

This species is very similar to *elongatus* Knight, but has the rostrum distinctly longer: it extends beyond the hind coxae to near the middle of the venter.

MALE.—Length 3.80, width 1.25. Head black, width 0.61; vertex and area bordering eyes paler, 0.32. Rostrum reaching to middle of venter; yellowish, apex and basal segment black. Antennae, first segment, length 0.28, fuscous at base; second, 1.22, yellow; third, 0.86, yellowish to dusky; fourth, 0.44, dusky. Pronotum, length 0.64, width at base 1.11; black, strongly shining. Scutellum and ventral surface black. Hemelytra uniformly black, strongly shining; clothed with minute, dusky to black pubescence; emboliar margins nearly straight. Membrane and veins uniformly fuscous, apex of cuneus scarcely paler. Legs straw colored to yellowish, devoid of black spots; bases of hind coxae and apices of tarsi fuscous. Venter black, strongly shining.

FEMALE.—Length 3.90, width 1.34; very similar to male in form and coloration.

FOOD PLANT.—Hazelnut (*Corylus americana*); a single specimen was collected on hickory (*Carya ovata*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, New England, New York.

Illinois Records.—Thirty-two males and 42 females, taken June 3 to July 27, are from Algonquin, Antioch, Dolson, Elizabeth, Galena, Galesburg, Grandview, Hardin, Monticello, Oregon, Palos Park, White Pines Forest State Park.

Microphylellus tumidifrons Knight

Microphylellus tumidifrons Knight (1923*d*, p. 455).

Known only from Nova Scotia.

Microsynamma Fieber

Microsynamma bohemanni (Fallen)

Phytocoris bohemanni Fallen (1829, p. 106).

This species is distinguished from others by its broad, flat vertex with a basal carina.

MALE.—Length 4.00, width 1.60. Head width 0.84, vertex 0.43; vertex flat, basal carina distinct, an impressed mark evident on either side near eye; head mostly black, with juga and a broad area bordering front of eyes and sides of vertex, yellowish. Rostrum, length 1.51, extending nearly to tips of hind coxae. Antennae, first segment, length 0.23; second, 1.03; third, 0.52; fourth, 0.30; black. Pronotum, length 0.64, width at base 1.21; black, with area between and behind calli, and spot on either side in front of calli, pallid to yellowish. Dorsum clothed with fine, short, yellowish, simple pubes-

cence. Hemelytra pallid, translucent; apex of cuneus, apical half of corium and embolium, and clavus except in central area near tip of scutellum, dark brown to black; membrane pale brown, areoles and veins clear to yellowish. Legs black; tips of coxae, bases and tips of femora, and tibiae except for setigerous spots and spines, pale yellowish.

FEMALE.—Length 3.80, width 1.62. Head width, 0.86, vertex 0.45. Antennae, first segment, length 0.22; second, 0.92; third, 0.56; fourth, 0.39. Pronotum, length 0.62, width at base 1.21. More robust than male and usually lighter in color.

HOST PLANT.—Willow (*Salix* sp.).

KNOWN DISTRIBUTION.—British Columbia, Colorado, Illinois, Indiana, Iowa, Michigan, Newfoundland, New Jersey, New York, Ohio, Oregon, Vermont, Washington; Europe.

Illinois Record.—NORTHERN ILLINOIS: 1 ♂, 2 ♀.

Psallus Fieber

KEY TO SPECIES

1. Second antennal segment with four or five black spots, fig. 89; membrane with a conspicuous black mark on margin behind apex of cuneus; dorsum thickly covered with pale fuscous dots........... **seriatus**, p. 45
   Second antennal segment either black, or pale without distinct black spots. 2
2. Second antennal segment yellowish, black only at base... **amorphae**, p. 44
   Second antennal segment black...... 3
3. Dorsum chiefly red; head, pronotal disk and scutellum flecked with fuscous; cuneus red with a narrow area at base light; length 3.60..... .... **alnicola**, p. 44
   Dorsum black or fuscous, never distinctly flecked.................. 4
4. Femora pale or fulvous, or pale with black spots, but without black line on dorsal margin................ 5
   Femora black, or pale to yellowish with spots and a dark line on dorsal margin......................... 6
5. Femora uniformly pale or yellowish; dorsum uniformly black; length 3.50.............. **strobicola**, p. 45
   Femora fulvous, becoming dusky, with one or two black dots on dorsal aspect near apex, hind femora obscured with fuscous; length 2.60–3.00................. **bakeri**, p. 45
6. Length of second antennal segment more than three-fourths width of pronotum at base.............. 7
   Length of second antennal segment less than three-fourths width of pronotum a base................ 11
7. Scutellum more or less pale at lateral margins, rarely entirely black; if scutellum black, cuneus paler or dusky at apex only; cuneus usually pale, sometimes slightly infuscated at apex; pale areas of legs and hemelytra tinged with reddish yellow.... ..... **alnicenatus**, p. 44
   Scutellum black; cuneus always partly black, frequently paler at base; pale areas of legs and hemelytra never tinged with reddish yellow........ 8
8. Rostrum reaching hind margins of posterior coxae; hemelytra uniformly black; femora black with pale apices; length 3.60.............. .... **morrisoni**, p. 45
   Rostrum scarcely surpassing hind margins of middle coxae.......... 9
9. Femora pale, a dark line forming on dorsal margin, anterior face with black spots and occasionally becoming uniformly dusky; tip of embolium and spot on base of corium almost colorless; length 4.50.. .... **parshleyi**, p. 44
   Femora black but with light-colored apices......................... 10
10. Length 2.90–3.10; deep black, with scalelike, silvery white pubescence. .... **astericola**, p. 45
    Length 3.50–4.00; very dark brown, hemelytra sparsely clothed with silvery, silky hairs intermixed with more erect, yellowish pubescence.. .... **fuscatus**, p. 44
11. Antennae entirely pale, pubescence dusky; legs black; apices of femora and tibiae pale, spines with small fuscous spots at bases........... .... **piceicola**, p. 44
    Antennae black, or at least first segment black.................... 12
12. Legs dull yellow brown to dark brown; femora sometimes nearly black but never paler at apices, always tinged with brownish and reddish, hind

pair strongly thickened; coxae and tibiae dull yellow brown to dark brown, more or less tinged with reddish............**ancorifer,** p. 46

Legs chiefly black; femora more slender, black, apices of front and middle pairs pale; coxae deep black; tibiae very light yellow to dull yellow brown, black spots at bases of spines.......**drakei,** p. 46

Psallus parshleyi Knight

Psallus parshleyi Knight (1923*d*, p. 465).

The color aspect of this species is suggestive of *Plagiognathus obscurus fraternus* Uhler, but *Psallus parshleyi* is to be distinguished by the sericeous, semiscalelike pubescence on its pleura and dorsum.

MALE.—Length 4.50, width 1.70. Rostrum just reaching hind margins of middle coxae. Second antennal segment, length 1.26. Pronotum, width at base 1.37. Body black, basal half of cuneus, tip of embolium, and a small translucent spot near base of corium, pale. Legs pale yellowish; coxae fuscous at base; femora with dark line forming above and below on apical half, anterior face with three or four spots on apical half.

FEMALE.—Length 4.00, width 1.66; more robust than male but very similar in coloration.

FOOD PLANT.—Birch (*Betula pumila*).

KNOWN DISTRIBUTION.—Illinois, Massachusetts, Minnesota, New York.

Illinois Record.—ANTIOCH: July 5-7, 1932, Frison *et al.*, 23 ♂, 16 ♀.

Psallus fuscatus Knight

Psallus parshleyi var. *fuscatus* Knight (1923*d*, p. 466).

This species is allied to *parshleyi* Knight, but is distinguished by its smaller size and uniformly black femora and hemelytra.

MALE.—Length 3.70, width 1.40. Rostrum reaching posterior margins of hind coxae. Second antennal segment, length 0.95, black. Pronotum, width at base 1.08. Body sparsely clothed with silvery, silky hairs intermixed with more erect yellowish pubescence. Body black, paler areas appearing very dark brown, cuneus uniformly black like corium. Legs black, tips of femora and tibiae yellowish, tibial spines with prominent black spots at bases.

FEMALE.—Length 3.30, width 1.40; very similar to male in color and pubescence.

HOST PLANT.—Alder (*Alnus rugosa*).

KNOWN DISTRIBUTION. — Illinois and Minnesota.

Illinois Records. — DOLSON: June 25, 1932, Rocky Branch, Frison & Mohr, 1 ♀. EICHORN: June 24, 1932, on *Alnus rugosa*, Ross, Dozier & Park, 6 ♂, 10 ♀; June 13, 1934, DeLong & Ross, 2 ♂, 1 ♀.

Psallus amorphae Knight

Psallus amorphae Knight (1930*b*, p. 125).

This species is black, with the second antennal segment yellow except at the base.

ADULTS.—Length 3.00–3.20, width 1.20–1.30. Rostrum extending to hind margins of middle coxae. Second antennal segment, length 0.87, yellow, black at base; pronotum, width at base 0.99. Body black, dorsum and sides clothed with rather closely appressed silvery, silky to scalelike pubescence.

FOOD PLANTS. — Lead plant (*Amorpha canescens* and *A. fruticosa*).

KNOWN DISTRIBUTION.—Previously known only from Iowa and Minnesota.

Illinois Records.—GRAND DETOUR: July 2, 1932, Dozier & Mohr, 5 ♀. MOUNDS: May 23, 1932, H. L. Dozier, 1 ♂. OQUAWKA: June 13, 1932, H. L. Dozier, 2 ♂. STARVED ROCK STATE PARK: July 14, 1932, Dozier & Park, 1 ♀.

Psallus alnicola Douglas & Scott

Psallus alnicola Douglas and Scott (1865, p. 414).

Not taken in Illinois; known from Colorado, Idaho, Michigan, Minnesota, New Hampshire, New York, Oregon, Washington; Europe. Breeds on alder (*Alnus rugosa*) in cool, humid surroundings.

Psallus alnicenatus Knight

Psallus alnicenatus Knight (1923*d*, p. 466).

Not taken in Illinois; known from Michigan, Minnesota and New York.

Psallus piceicola Knight

Psallus piceicola Knight (1923*d*, p. 469).

This species is very dark brown, almost black; the hemelytra are more brownish than the rest of the dorsum, and the antennae and base of the cuneus are pale.

MALE.—Length 3.00, width 1.08. Head width 0.60, vertex at basal margin 0.34, narrowest point on front 0.27; strongly inclined vertically. Rostrum extending behind posterior coxae. Antennae with first segment pale; second, 0.66 in length, pale with dusky tinge. Pronotum, width at base 0.91. Hemelytra fusco-brownish to black, base of cuneus pale; clothed with golden to dusky pubescence intermixed with more closely appressed, silvery, woolly pubescence. Legs very dark brown, apices of femora and tibiae pale; tibial spines black, a fuscous spot at base of each.

FEMALE.—Length 2.90, width 1.30; more robust than male, but very similar in coloration; hemelytra usually more brownish.

FOOD PLANT.—Spruce (*Picea* sp.).

KNOWN DISTRIBUTION.—Illinois, Minnesota, New York.

Illinois Record.—ANTIOCH: July 5-7, 1932, on spruce, Frison *et al.*, 2 ♂, 2 ♀.

Psallus strobicola Knight

Psallus strobicola Knight (1923*d*, p. 467).

This species is very dark fuscous, almost black; the antennae and the legs, except for the coxae, are yellow; the body is clothed with closely appressed, silvery, silky pubescence.

MALE.—Length 3.50, width 1.33. Head width 0.72, vertex 0.33 measured across posterior corners of eyes; black; eyes reddish brown. Rostrum, length 1.25, reaching hind margins of posterior coxae, yellow, basal segment black. Antennae yellow; first segment, length 0.17; second, 0.97; third, 0.62; fourth, 0.39, slightly dusky. Pronotum, length 0.53, width at base 1.08. Hemelytra uniformly very dark fuscous; clothed with closely appressed, silvery, silky pubescence intermixed with more erect dark pubescence similar to that of the pronotum and scutellum; emboliar margins very slightly arcuate; membrane and veins uniformly fuscous, border of cuneus not perceptibly paler. Legs yellow, coxae almost black except at apex; tibial spines black without dark spots at bases.

FEMALE.—Length 3.10, width 1.36; more robust than male, but otherwise very similar.

FOOD PLANT.—Pine (*Pinus strobus*).

KNOWN DISTRIBUTION.—Illinois, Minnesota, New York, Ohio, Quebec.

Illinois Records.—GALENA: June 30, 1932, on *Pinus strobus*, Dozier & Mohr, 3 ♂, 4 ♀. KEITHSBURG: June 15, 1932, H. L. Dozier, 1 ♂, 4 ♀. MOUNT CARROLL: June 15, 1932, on *Pinus strobus*, Frison & Mohr, 2 ♂, 1 ♀. URBANA: June 11, 1915, 1 ♀. WHITE PINES FOREST STATE PARK: July 4, 1932, on grasses, Dozier & Mohr, 1 ♂; July 4, 1932, on *Pinus strobus*, Dozier & Mohr, 2 ♀.

Psallus astericola Knight

Psallus astericola Knight (1930*b*, p. 125).

Known only from Iowa. Breeds on prairie aster (*Aster sericeus*), which grows only on undisturbed, native prairie.

Psallus morrisoni Knight

Psallus morrisoni Knight (1923*d*, p. 464).

Not taken in Illinois; known from Massachusetts, Minnesota, New York.

Psallus bakeri (Bergroth)

Agalliastes signatus Uhler (1895, p. 55). *Preoccupied.*

Chlamydatus bakeri Bergroth (1898, p. 35).

This species has previously been placed in the genus *Chlamydatus*, but its two types of pubescence, its longer antennae, and the form of its pseudarolia place it in *Psallus*.

ADULTS.—Length 2.60–2.90. General color fuscous to black, two spots on vertex and frequently base of cuneus paler. Legs yellowish to dusky yellow; hind femora frequently dark fuscous; femora with two or three black dots on dorsal surface before apex; tibiae pale, spines black with a prominent black spot at base of each. Clothed with pale, simple hairs intermixed on dorsum with some silky, silvery pubescence.

FOOD PLANT. — Sage brush (*Artemisia* sp.).

KNOWN DISTRIBUTION. — Occurs frequently in the states west of the Mississippi River.

Illinois Records.—GRAND DETOUR: July 12, 1934, DeLong & Ross, 3 ♂, 2 ♀. OREGON: July 4, 1932, on *Artemisia canadensis*, Dozier & Mohr, 10 ♂, 33 ♀. ROCKTON: July 5, 1932, Dozier & Mohr, 2 ♀.

Psallus seriatus (Reuter)

Atomoscelis seriatus Reuter (1876, p. 91).

This is the well-known cotton flea hopper, distinguished by its pale color, the black

spots on its second antennal segment, and the conspicuous black marks on the margin of the membrane, fig. 89.

MALE.—Length 3.10, width 1.30. Head width 0.69, vertex 0.34. Rostrum reaching behind posterior coxae to third ventral segment. Antennae, first segment, 0.17, pale, a group of three setigerous black spots before apex, some of which form narrow annulations; second, 0.82, pale, with four or five conspicuous black spots on dorsal aspect. Pronotum, length 0.56, width at base 1.09; pale, finely dotted with fuscous. Hemelytra pale, dotted with small and a few larger fuscous spots. Dorsum clothed with simple fuscous hairs intermixed with deciduous, silvery scalelike pubescence which in part is arranged in tufts at posterior edge of larger fuscous spots; roughly handled specimens or old living adults may lose pubescence. Membrane clear and shaded with fuscous; a clear spot surrounding black mark on margin behind cuneus; veins white. Legs pale; femora dotted with fuscous; tibiae with two rows of black spines, each with a prominent black spot around base.

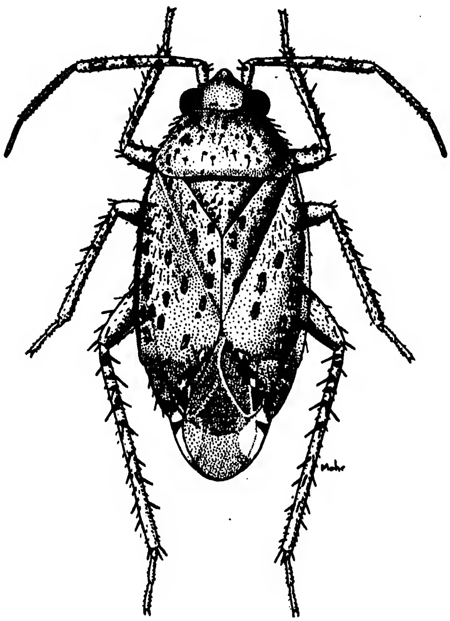


Fig. 89.—*Psallus seriatus*, ♀.

FEMALE.—Length 2.80, width 1.40; slightly more robust than male, but very similar in color and pubescence.

HOST PLANTS.—The nymphs and adults feed on the tiny flower buds of cotton just as they appear, causing the buds to drop. The wild hosts of this insect may be several herbaceous weeds, but the preferred food plants appear to be several species of *Croton*, especially *C. texensis*. In Illinois, specimens have been taken on snowberry (*Symphoricarpos orbiculatus*), horse mint (*Monarda punctata*) and daisy (*Chrysanthemum* sp.), as well as on cotton and *Croton capitatus*.

KNOWN DISTRIBUTION.—*Psallus seriatus* is known from all the southern states and ranges northward into Nebraska and Colorado and westward into Arizona and southern California. Its range coincides rather closely with the distribution of the various species of *Croton*.

Illinois Records.—One hundred one males and 57 females, taken June 15 to Sept. 6, are from Centralia, Fulton, Golconda, Harrisburg, Havana, Keithsburg, Meredosia, Metropolis, Patoka, St. Anne.

Psallus ancorifer (Fieber)

Apocremnus ancorifer Fieber (1859, p. 336).

Not taken in Illinois; known only from New York and Pennsylvania.

Psallus drakei Knight

Psallus drakei Knight (1923*d*, p. 464).

Not taken in Illinois; known only from Colorado and New York.

Lepidopsallus Knight

KEY TO SPECIES

1. Rostrum extending beyond posterior coxae 2
   Rostrum not extending beyond posterior coxae 3
2. First and second antennal segments pale yellowish; sides of venter without scalelike pubescence .... **claricornis**, p. 47
   First antennal segment black, base of second dusky; sides of venter and pleura bearing scalelike pubescence .... **rostratus**, p. 47
3. First antennal segment pale yellow .. 4
   First antennal segment very dark brown or black 5
4. First antennal segment short, second segment six times as long as first segment; reddish color dominant,

darkest forms brownish red....... ....**miniatus**, p. 47
First antennal segment longer, second segment four times as long as first segment; color brown to fuscous, never reddish.........**nyssae**, p. 48

5. Combined lengths of third and fourth antennal segments greater than length of second segment; second antennal segment thickened in both sexes, cylindrical and as thick as first segment; black, length 2.60 ....**minusculus**, p. 47
Combined lengths of third and fourth antennal segments less than or scarcely equal to length of second segment; second antennal segment more slender in female, distinctly thinner on basal half and not so thick as first segment............ 6
6. Color uniformly black; second antennal segment always black; scalelike pubescence silvery white...... ......**rubidus** var. **atricolor**, p. 47
Color black with reddish areas; second antennal segment usually light at apex, scalelike pubescence yellowish ....**rubidus** var. **rubidus**, p. 47

Lepidopsallus rubidus (Uhler)

Sthenarus rubidus Uhler (1895, p. 41).

MALE.—Length 3.20, width 1.50; ground color black; hemelytra reddish brown with fuscous; embolium and cuneus strongly reddish; membrane uniformly fuscous. Body clothed with pale yellowish, closely appressed, scalelike pubescence intermixed with more erect, dusky, simple pubescence. Femora fusco-brownish, tinged with reddish; tibiae brownish to reddish, beset with prominent black spines. Antennae fuscous to ferruginous; first segment, length 0.16; second, 0.64, its length two-thirds as great as width of head, apical three-fourths equal in thickness to first segment, but more slender on basal one-fourth, usually paler on apical half; third, 0.36; fourth, 0.31. Pronotum, length 0.62, width at base 2.38.

FEMALE.—Length 3.50, width 1.53; head narrower than in male; second antennal segment gradually becoming thicker toward apex, but not quite attaining thickness of first segment.

Specimens which are uniformly black in color, rather than not quite so, and having silvery rather than yellowish pubescence, have been named *rubidus atricolor* Knight (1923*d*, p. 472). These were taken in company with typical specimens at Dolson.

FOOD PLANTS.—Willow (*Salix* sp.). A few specimens were taken in Illinois on plantain (*Plantago aristata*) and black locust (*Robinia pseudoacacia*).

KNOWN DISTRIBUTION.—Common in the eastern United States and Canada; also known from California, Colorado, Idaho, Texas, Utah, Washington.

Illinois Records. — Twenty-two males and 49 females, taken June 22 to Aug. 19, are from Browns, Decatur, Dolson, Eichorn, Elizabethtown, Galesburg, Golconda, Grand Detour, Grand Tower, Havana, Herod, Kansas, Meredosia, Savanna, Shawneetown, Starved Rock State Park, York.

Lepidopsallus claricornis Knight

Lepidopsallus claricornis Knight (1923*d*, p. 471).

Not taken in Illinois; known from New Jersey.

Lepidopsallus rostratus Knight

Lepidopsallus rostratus Knight (1923*d*, p. 470).

Not taken in Illinois; known from Iowa and Minnesota.

Lepidopsallus minusculus Knight

Lepidopsallus minusculus Knight (1923*d*, p. 472).

Not taken in Illinois; known from New York.

Lepidopsallus miniatus Knight

Lepidopsallus miniatus Knight (1926*b*, p. 226).

This species is distinguished by its reddish color and relative lengths of the first two antennal segments.

MALE.—Length 2.70, width 1.60. Head width 0.73, vertex 0.30. Rostrum reaching to middle of hind coxae. Antennae uniformly pale yellowish; first segment, length 0.13; second, 0.78; third, 0.34. Pronotum, length 0.56, width at base 1.21. General color uniform red to red with fuscous shading; membrane fuscous, veins red. Legs fusco-reddish; tips of femora and tibiae pale; spines and spots at bases black.

FEMALE.—Length 2.80, width 1.50. Head

width 0.77, vertex 0.36. Antennae pale yellowish; first segment, 0.17; second, 0.69. Pronotum, length 0.58, width at base, 1.23. Color more reddish than in male, sometimes pronotum and scutellum more fuscous than red. Clothed with silvery white, scalelike pubescence intermixed with simple, yellowish to fuscous pubescence.

FOOD PLANT.—Post oak (*Quercus stellata*).

KNOWN DISTRIBUTION.—Described from Florida, and now known from Illinois, Mississippi, Texas.

Illinois Records.—DONGOLA: May 10-12, 1917, 1 ♂, 1 ♀. DUBOIS: May 21-24, 1917, 2 ♂, 6 ♀. MEREDOSIA: May 29, 1917, 2 ♀.

Lepidopsallus nyssae Johnston

Lepidopsallus nyssae Johnston (1930, p. 299).

This is allied to *miniatus* Knight, but is distinguished by its pale brownish color and the relative lengths of the first and second antennal segments.

MALE.—Length 3.00, width 1.40. Head width 0.73, vertex 0.30. Rostrum just attaining posterior margins of middle coxae. Antennae pale yellowish, last two segments dusky; first segment, length 0.21; second, 0.82; third, 0.34; fourth, 0.23. Pronotum, length 0.61, width at base 1.21. General color pale brown to fuscous, never reddish as in *miniatus*; head, pronotum and scutellum dark fuscous to black; hemelytra pale brownish, sometimes darker; cuneus uniformly translucent like the corium. Clothed with silvery, scalelike pubescence intermixed with pale yellowish to fuscous simple pubescence. Legs dark brown; tibiae pale with black spines arising from brown spots.

FEMALE.—Length 3.00, width 1.60. Head width 0.79, vertex 0.37. Antennae uniformly pale yellowish; first segment, length 0.14; second, 0.67. Pronotum, length 0.67, width at base 1.26. Color much paler than in male, dorsum uniformly pale brownish except anterior half of pronotum and head, which are fuscous to blackish. Legs uniformly pale.

FOOD PLANT.—Black gum (*Nyssa sylvatica*).

KNOWN DISTRIBUTION.—Described from Texas. Now known in Illinois also.

Illinois Record.—ELIZABETHTOWN: May 27-31, 1932, H. L. Dozier, 1 ♂.

Reuteroscopus Kirkaldy

KEY TO SPECIES

Membrane uniformly fuscous except for clear spot at apex of cuneus and smaller spot just beyond; scutellum and clavus black, fig. 90............**ornatus,** p. 48

Membrane with many small, fuscous marks; scutellum and clavus yellowish, dotted with fuscous...**sulphureus,** p. 49

Reuteroscopus ornatus (Reuter)

Episcopus ornatus Reuter (1876, p. 90).

ADULTS.—Fig. 90. Length 3.40, width 1.30; general color yellowish green, pronotum with darker green; scutellum, clavus, membrane, and bar across apex of corium, fuscous, dark color forming a well-marked Greek cross.

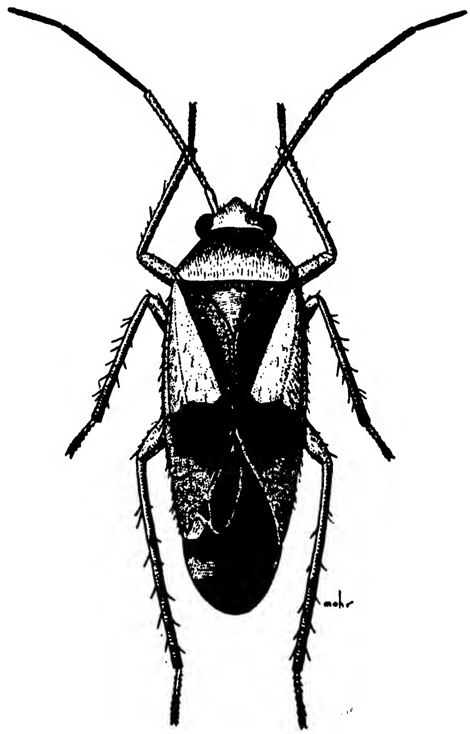


Fig. 90.—*Reuteroscopus ornatus*, ♀.

FOOD PLANTS.—Ragweed (*Ambrosia* sp.). A few Illinois specimens were taken also on red cedar (*Juniperus virginiana*), basswood (*Tilia* sp.) and lamb's quarter (*Chenopodium album*); the first two are undoubtedly "sitting" records.

KNOWN DISTRIBUTION. — Common in

North America east of the 100th meridian.

Illinois Records.—One hundred three males and 77 females, taken May 27 to Sept. 24, are from Albion, Alto Pass, Ashley, Bloomington, Cave-in-Rock, Champaign, Chicago, Darwin, Decatur, Delavan, Dolson, Dubois, East St. Louis, Elizabethtown, Fountain Bluff, Galena, Galesburg, Golconda, Grafton, Grand Detour, Grand Tower, Grandview, Grayville, Hardin, Havana, Herod, Kampsville, Kankakee, Kansas, Kappa, Karnak, Keithsburg, Lawrenceville, Metropolis, Monticello, Mounds, Mount Carmel, Muncie, Murphysboro, Oquawka, Palos Park, Pulaski, St. Joseph, Snyder, Springfield, Starved Rock State Park, Ullin, Urbana, York.

Reuteroscopus sulphureus (Reuter)

Psallus sulphureus Reuter (1907, p. 23).

ADULTS.—Length 3.30, width 1.18. General color yellow, sometimes with a greenish tinge. Inner apical angles of corium, tip of clavus, anal area of membrane, and spot on inner angle of cuneus, fuscous. Body clothed with yellowish to fuscous pubescence, base of each hair with a small fuscous spot, also sparsely set with small tufts of silvery scalelike hairs, arranged in series on median line and outer margins of head and pronotal disk, and present to some extent on clavus and corium; membrane with dark spots on a clear background, fuscous color forming a short transverse bar touching margin just beyond tip of cuneus, each side of this clear but with another, larger fuscous area situated just before apex; femora thickly speckled with small, pale fuscous spots.

HOST PLANTS.—I have collected this species on ragweed (*Ambrosia* sp.) and found it breeding on *Sida spinosa* in Georgia. Specimens were collected in Illinois on lamb's quarter (*Chenopodium album*) and snowberry (*Symphoricarpos orbiculatus*) as well as on ragweed.

KNOWN DISTRIBUTION.—This species is common in the southern states and appears to find its northern limits of distribution in central Illinois.

Illinois Records. — Twenty-two males and 29 females, collected June 5 to Oct. 2, are from Alton, Alto Pass, Ashley, Cave-in-Rock, Darwin, Dolson, Dongola, Dubois, Elizabethtown, Fairfield, Golconda, Hardin, Havana, Herod, Lawrenceville, Metropolis, Oquawka, Shawneetown, Vienna, York.

Criocoris Fieber

Criocoris saliens (Reuter)

Strongylotes saliens Reuter (1876, p. 88).

MALE.—Fig. 91. Length 2.70, width 1.40. Head and body black, shining, clothed with white scalelike pubescence intermixed with more erect pubescence; first and second antennal segments strongly thickened, thickness of second segment half as great as width of vertex.

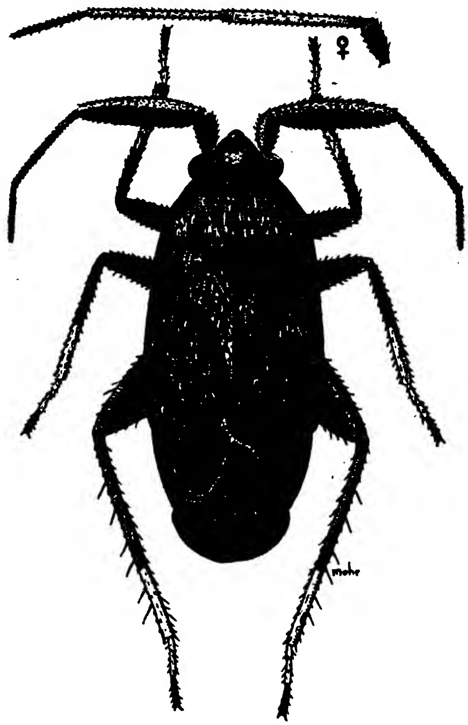


Fig. 91.—*Criocoris saliens*, ♂.

FEMALE.—Length 3.00, width 1.40; black, pubescence similar to that of male; antennae yellowish brown, entire first segment and base of second, black; second segment slender, scarcely more than half as thick as first.

HOST PLANT.—Bedstraw (*Galium aparine*.)

KNOWN DISTRIBUTION.—California, Idaho, Illinois, Iowa, Kansas, Maryland, Massachusetts, Minnesota, New Jersey, New York, Ontario, Pennsylvania, Texas, Virginia, Washington.

Illinois Records.—ANTIOCH: July 5-7, 1932, Frison *et al.*, 1 ♂. ELIZABETHTOWN: May 27-31, 1932, H. L. Dozier, 1 ♀. GRAND TOWER: May 12, 1932, Frison, Ross

& Mohr, 6 ♂. HEROD: May 29, 1935, Ross & Mohr, 4 ♀. JONESBORO: May 6, 1932, on *Galium aparine*, H. L. Dozier, 16 ♂, 5 ♀. TEXAS CITY: May 12, 1936, Ross, Mohr & Burks, 1 ♂.

Rhinacloa Reuter

Rhinacloa forticornis Reuter

Rhinacloa forticornis Reuter (1876, p. 89).

This species is distinguished by its small size, scalelike pubescence and thickened second antennal segment.

MALE.—Length 2.20, width 0.95. Head width 0.65, vertex 0.26. Rostrum reaching apices of hind coxae, length 0.86. Antennae, first segment, length 0.13, thickness 0.06, black; second, length 0.56, thickness 0.07, cylindrical, clothed with fine, short pubescence, black; third, length 0.28, pale, slender; fourth, length 0.21, fuscous. Pronotum, length 0.36, width at base 0.85, clothed with fine, closely appressed, silvery, scalelike pubescence intermixed with dusky to black simple pubescence. General color fuscous to black, hemelytra paler at base, embolium with reddish spot at apex; membrane dusky. Legs brownish to fuscous; tibiae pale with spines and dots at bases of spines black.

FEMALE.—Length 0.21, width 1.00. Head width 0.60, vertex 0.30. Antennae, first segment, length 0.13, thickness 0.06; second, length 0.47, slender on basal half, clavate apically (thickness 0.07); third, length 0.30, slender, pale; fourth, length 0.20, fuscous. Pronotum, length 0.39, width at base 0.86. Color and pubescence very similar to those of male.

KNOWN DISTRIBUTION. — Common in Texas and westward. Rare in Illinois, Iowa and Missouri.

Illinois Record. — URBANA: June 29, 1914, C. A. Hart, 1 ♀.

Leucopoecila Reuter

Leucopoecila albofasciata Reuter

Leucopoecila albofasciata Reuter (1907, p. 26).

This species is distinguished by its peculiar antennae, fig. 92. The dorsum is dark with a pale fascia across the clavus.

MALE.—Fig. 92. Length 2.40, width 0.95. Head width 0.74, vertex 0.39, strongly vertical in position. Rostrum reaching slightly beyond hind coxae or to fourth ventral segment, length 1.04. Antennae, first segment, length 0.26, width 0.11, constricted at base, black; second, length 0.43, somewhat flattened, broader at base, width 0.12, clothed with short, black pubescence, ventral aspect black with an elongate, pale sensory pit which occupies nearly whole length of seg-

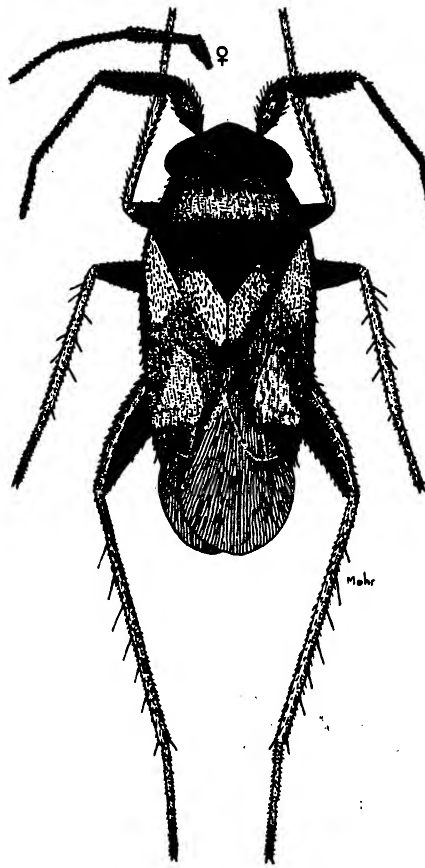


Fig. 92.—*Leucopoecila albofasciata*, ♂.

ment; third, length 0.52, slender, black; fourth, length 0.43, black. Pronotum, length 0.43, width at base 0.91. Scutellum distinctly convex above level of clavus. Dorsum clothed with pale, simple pubescence. General color black; a prominent, slightly irregular pale band extends across middle of clavus and basal half of corium; base of cuneus and a triangular spot just before on corium, pale; membrane fuscous, paler at base. Legs black, front and middle femora yellowish at apex, tibiae pale, spines black but without spots at bases, tarsi pale to fuscous, apical segment darker.

FEMALE.—Length 2.60, width 1.08. Head width 0.73, vertex 0.38. Antennae, first seg-

ment, length 0.17, width 0.06; second, length 0.49, width 0.06, more slender on basal half, no sensory pit evident; third, length 0.43; fourth, length 0.35, black. Form slightly more robust than that of male, but very similar in pubescence and coloration.

KNOWN DISTRIBUTION.—This species is widely distributed in the southern and southwestern United States. It has been reported as injurious to grass on golf greens at St. Louis, Mo., and about New York, N. Y.

Illinois Records.—ALTON: June 26, 1934, DeLong & Ross, 1 ♂. CARBONDALE: Aug. 17, 1891, sweepings from grape, G. H. French, 1 ♀. CAVE-IN-ROCK: Oct. 2, 1934, Frison & Ross, 1 ♂. FOUNTAIN BLUFF: Aug. 10, 1891, Hart & Shiga, 1 ♂. METROPOLIS: Aug. 18, 1891, sweepings from *Coreopsis* sp., etc., C. A. Hart, 1 ♀.

Lopus Hahn

No Illinois species; *Lopus decolor* (Fallen) occurs in Connecticut, District of Columbia, Maine, Maryland, Massachusetts, New Jersey, New York, Ontario, Quebec, Virginia. It breeds on sedges (*Juncus dudleyi* and other species).

Amblytylus Fieber

No Illinois species; *Amblytylus nasutus* (Kirschbaum) occurs in Indiana, Massachusetts, Michigan; Europe.

Atractotomus Fieber

No Illinois species; *Atractotomus crataegi* Knight is known from Iowa.

Macrotylus Fieber

KEY TO SPECIES

Chiefly green, ventral surface yellowish, femora black along dorsal margin, fig. 93; length 2.30.......... **amoenus**, p. 51

Uniformly black, membrane with four white spots; length 3.00.................... **sexguttatus**, p. 51

Macrotylus amoenus Reuter

Macrotylus amoenus Reuter (1909, p. 75).

ADULTS.—Fig. 93. Length 2.30, width 0.80; yellowish green, hemelytra darker green; first and second antennal segments black, apices white; tibiae black; femora with black bar on dorsal margin; cuneus opaque white with greenish tint, an oblique

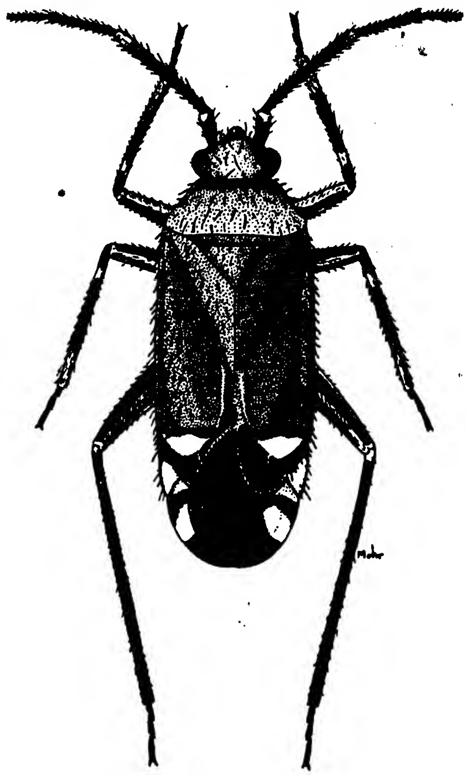


Fig. 93.—*Macrotylus amoenus*, ♀.

black bar across middle; membrane fuscous, a clear spot on either side near margin.

HOST PLANT.—New England aster (*Aster novae-angliae*).

KNOWN DISTRIBUTION.—Originally described from Connecticut and later found in Rhode Island and the Delaware Water Gap.

Illinois Records.—EVERGREEN PARK: July 1, 1935, Ross & DeLong, 1 ♀; Aug. 23, 1934, Ross & DeLong, 1 ♀. GRAYSLAKE: June 10, 1936, breeding on *Aster novae-angliae*, Ross & Burks, 59 ♂ 51 ♀. OAK LAWN: July 1, 1936, DeLong & Ross, 3 ♂ 4 ♀.

Macrotylus sexguttatus (Provancher)

Amblytylus sexguttatus Provancher (1887, p. 150).

Not taken in Illinois; known from Connecticut, Michigan, Minnesota, New York, Ontario, Pennsylvania. Host plant, aster (*Aster undulatus*).

Orectoderus Uhler

Orectoderus obliquus Uhler

Orectoderus obliquus Uhler (1876, p. 320).

MALE.—Length 8.00, width 2.30. Head elongate, inclined, width 1.22, vertex 0.60. Rostrum extending to near apex of middle coxae. Antennae with first segment yellowish, length 0.47; second, 2.42, apical one-third distinctly thickened, yellowish to orange, thick part black; third, 1.55; fourth, 0.86; last two segments orange. Pronotum, length 1.30, width at base 1.81; lateral margins rounded, slightly concave. General color black, shining; legs yellowish to orange colored. Body sparsely clothed with short, yellowish pubescence. A color variation has the basal half of cuneus and basal one-third of corium white.

FEMALE.—Length 6.00, width of abdomen 2.40. Brachypterous, antlike in form, head broader than pronotum; hemelytra greatly reduced, extending to base of abdomen, there turning upward, the tips vertical and tapering to a point; two basal segments of abdomen constricted into a pedicel, the remaining segments forming a globose portion, the pleural fold prominent. General color piceous to black; antennae yellowish to orange, tips of second and third segments blackish.

HABITS.—Occurs on the ground among grasses and associated with ants.

KNOWN DISTRIBUTION.—Alberta, Colorado, Connecticut, Illinois, Maine, Manitoba, Massachusetts, Montana, New Brunswick, New Mexico, New York. Uhler (1876, p. 320) records this species from Illinois.

Teleorhinus Uhler

No Illinois species; *Teleorhinus tephrosicola* Knight is known from Missouri, New Jersey, New York, and may eventually be taken in Illinois. It breeds on hoary pea (*Tephrosia* sp.).

Coquillettia Uhler

Coquillettia amoena (Uhler)

Orectoderus amoenus Uhler (1877, p. 426).

MALE.—Length 6.40, width 1.77. Head width 0.90, vertex 0.41. Antennae dark brown; first segment, length 0.38; second, 2.20; third, 2.00; fourth, 0.95. Pronotum, length 0.99, width at base 1.43. General color dark orange brown; abdomen, tarsi and second antennal segment becoming fuscous; basal half of corium transparent, apical part bright orange brown, but with a slender dark brown margin; basal one-third of cuneus white, slightly translucent; membrane and apical two-thirds of cuneus very dark brown, almost black.

FEMALE.—Length 5.50, wingless; antlike in form, head wider than pronotum; abdomen with first two segments constricted to form a pedicel, remaining segments forming a globose, polished, minutely and sparsely haired gaster with conspicuous pleural fold. General color brown; third and fourth antennal segments and apex of second, tarsi, and apices of tibiae, fuscous to black; globose portion of abdomen, and tergite of second segment, dark chestnut to pitchy black.

KNOWN DISTRIBUTION.—Florida, Illinois, Iowa, New Mexico, North Carolina, Texas. The only Illinois record is that in the original description where Uhler stated: "Other specimens have been secured in . . . Illinois."

Occurs on high prairie among grasses and appears to be associated with ants, such as *Formica* (*Neoformica*) *pallide-fulva* var. *incerta* Emory. The wingless female bugs resemble this ant in form and color so nearly that one must look rather closely to separate them.

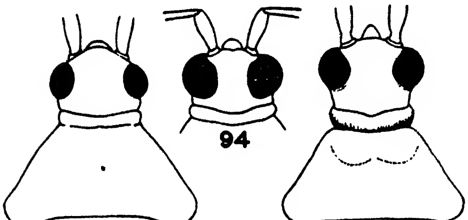
DICYPHINAE

KEY TO GENERA

1. Eyes large, postocular space of head less than half lateral width of an eye; first antennal segment always short, fig. 94 . . . . . **Cyrtopeltis**, p. 53
   Eyes small, postocular space much longer, figs. 95, 97; or first antennal segment very long, fig. 98 2
2. Hemelytra hyaline, completely transparent and glassy, with a well-defined, red or fuscous Y-shaped mark, fig. 98; pseudarolia absent, fig. 32; form broader . . . . **Hyaliodes**, p. 56
   Hemelytra opaque or at least milky, and with brown, scattered spots or widely suffused brownish areas; pseudarolia prominent, figs. 29, 53; form narrower, fig. 97 3
3. Pronotal disk with an arcuate, deep

furrow across middle at junction of wide and narrow portions, fig. 97.. .... **Dicyphus**, p. 53

Pronotal disk without such a furrow, fig. 96 4



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95

96

Fig. 94.—Head of *Cyrtopeltis tenuis.*

Fig. 95.—Head of *Macrolophus separatus.*

Fig. 96.—Head and pronotum of *Dicyphus agilis.*

4. Head mostly black; pronotum brown or black, at least on sides......... .... **Dicyphus**, p. 53

   Head and pronotum almost entirely greenish yellow................. .... **Macrolophus**, p. 55

Cyrtopeltis Reuter

No Illinois species; *Cyrtopeltis varians* (Distant) occurs in Arizona, California, Florida, Georgia, Mississippi, Missouri, South Carolina, Texas; Mexico and Central America; Puerto Rico and Grenada. It is known to breed on cultivated tomatoes, but in the wild state it feeds probably on related plants. It has been reported to be a tomato pest in Arizona, Georgia and Mississippi.

Dicyphus Fieber

KEY TO SPECIES

1. Length not over 3.00; corium with large black spot near apex........ .... **minimus**, p. 54

   Length more than 4.00; corium variously marked but without a large black spot near apex............. 2

2. Head entirely and pronotum mostly dark brown to black; pronotum usually with a pale median stripe.. .... **agilis**, p. 53

   Head with at least vertex behind eyes pale; pronotum in greater part dull yellow or reddish with only sides darkened..................... 3

3. Length of second antennal segment subequal to both maximum width and maximum length of pronotum. .... **vestitus**, p. 53

   Length of second antennal segment at least one-third greater than maximum width of pronotum and at least one-half greater than maximum length of pronotum......... 4

4. Second antennal segment uniformly black; scutellum mostly black; femora without reddish dots...... .... **gracilentus**, p. 54

   Second antennal segment with basal two-thirds pale; scutellum entirely reddish or yellowish; femora with numerous reddish dots........... 5

5. Elytra with numerous reddish streaks; length of postocular space subequal to distance between eyes......... .... **famelicus**, p. 54

   Elytra without reddish streaks; length of postocular space slightly more than one-half distance between eyes .... **discrepans**, p. 54

Dicyphus agilis (Uhler)

Idolocoris agilis Uhler (1877, p. 425).

MALE.—Length 3.40, width 0.90. General color pale yellowish; head, thorax and second segment of antennae chiefly black; hemelytra pale, lightly marked with fuscous, sometimes tinged with red.

FEMALE.—Length 4.50, width 1.10.

FOOD PLANT.—Raspberry (*Rubus odoratus* and doubtless others). In Illinois it was collected on walnut (*Juglans nigra*) and butternut (*J. cinerea*), but these are certainly "sitting" records.

KNOWN DISTRIBUTION.—Maine westward to British Columbia and southward to Virginia, through Illinois and Iowa.

Illinois Records.—Seven males and 16 females, taken June 2 to July 2, are from Algonquin, Dolson, Rocky Branch, Galesburg, Grand Detour, Grand View, Hardin, Manito, Savanna, Sheldon, Urbana.

Dicyphus vestitus Uhler

Dicyphus vestitus Uhler (1895, p. 46).
Dicyphus notatus Parshley (1922, p. 16).

ADULTS.—Length 3.80, width 1.20. Head width 0.60, vertex 0.26. Rostrum reaching to base of hind coxae. First antennal segment, length 0.36, reddish, black on base;

second, 0.91, yellowish, apical one-fourth black. Pronotum, length 0.58, width at base 0.95, basal margin deeply concave. General color pale, shaded with fuscous, scutellum black, basal angles pale; ventral surface black, shining. Legs pale, femora with small fuscous points.

KNOWN DISTRIBUTION.—Colorado, Illinois, Iowa, Minnesota, Ohio, South Dakota.

Illinois Records.—ALGONQUIN: Nov. 4, 1895, 1 ♀; May 8, 1897, 1 ♀. APPLE RIVER CANYON STATE PARK: June 2, 1933, Ross & Townsend, 1 ♀. BLOOMINGTON: July 18, 1932, T. H. Frison, 1 ♂, 3 ♀. CARY: May 14, 1936, Ross & Mohr, 1 ♀. FOUNTAIN BLUFF: Aug. 10, 1891, Hart & Shiga, 1 ♀. URBANA: Nov. 2, 1887, sweeping from grass and evergreens in arboretum, C. A. Hart, 1 ♀; April 30, 1892, in woods, Hart & Marten, 1 ♀. WILLOW SPRINGS: July 16, 1911, A. B. Wolcott, 2 ♂, 1 ♀, FM.

Dicyphus famelicus (Uhler)

Idolocoris famelicus Uhler (1878, p. 413).

ADULTS.—Length 4.80, width 1.20. Rostrum extending to second abdominal sternite. First antennal segment, length 0.47; second, 1.43, yellowish, apical one-third dark reddish. Pronotum, length 0.62, width at base 0.86, strongly sulcate on base. General color pale yellowish; head and thorax dull reddish; hemelytra and scutellum with dull reddish markings; membrane infuscated; veins and tip of cuneus reddish.

FOOD PLANT.—Raspberry (*Rubus odoratus*).

KNOWN DISTRIBUTION.—Illinois, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Ontario, Pennsylvania, Vermont, West Virginia, Wisconsin.

Illinois Record. — SAVANNA: July 11, 1917, 1 ♂.

Dicyphus minimus Uhler

Dicyphus minimus Uhler (1899, p. 59).

Not taken in Illinois; known from California, Colorado, District of Columbia, New Mexico.

Dicyphus discrepans Knight

Dicyphus discrepans Knight (1923*d*, p. 477).

Not yet collected in Illinois; known to occur in British Columbia, Michigan, Minnesota, New Hampshire, New York, North Dakota, Oregon, Washington. Feeds on aster (*Aster* sp.).

Dicyphus gracilentus Parshley

Dicyphus gracilentus Parshley (1922, p. 21).
Dicyphus vestitus Blatchley (1926*b*, p. 910) *not* Uhler. *Misidentification.*

ADULTS.—Fig. 97. Length 4.50, width 1.25. Head width 0.60, vertex 0.21. Rostrum reaching to second abdominal sternite.

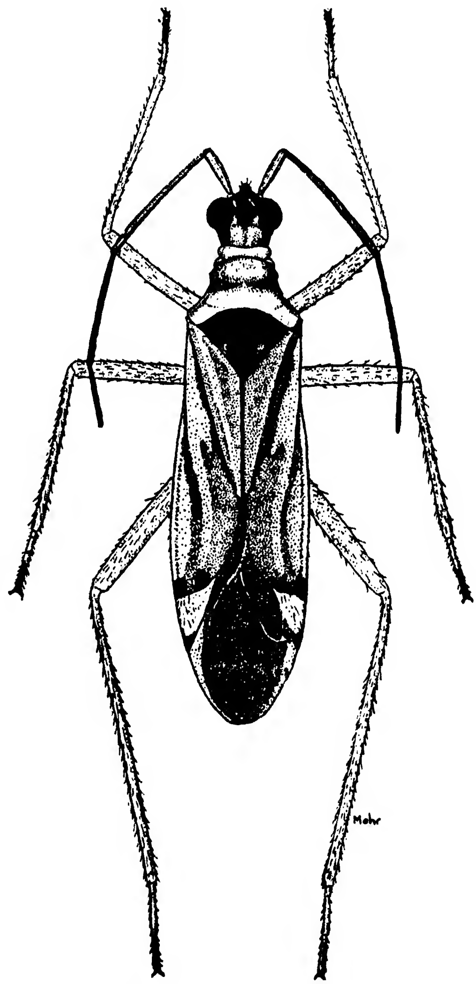


Fig. 97.—*Dicyphus gracilentus.*

First antennal segment, 0.43; second, 1.25, black. Pronotum, length 0.65, width at base 0.99, basal margin deeply concave. General color pale to yellowish, shaded with fuscous; scutellum and mesoscutum dull black, basal angles of scutellum yellowish; sternum and propleura dark brown, strongly shining.

Legs uniformly pale yellowish, without spots.

FOOD PLANT.—Leafcup (*Polymnia canadensis*).

KNOWN DISTRIBUTION.—Originally described from Illinois and known also from Indiana and Ohio.

Illinois Records.—Sixty-seven males and 66 females, taken April 4 to Oct. 29, are from Apple River Canyon State Park, Bloomington, Cave-in-Rock, Kappa, Oakwood, Savanna, Urbana, Zion.

Macrolophus Fieber

KEY TO SPECIES

1. Length of first antennal segment equal to or slightly greater than width of head across eyes; length of second segment distinctly greater than basal width of pronotum................. **tenuicornis**, p. 56
   Length of first antennal segment less than width of head across eyes... 2
2. Postocular space of head nearly equal to lateral width of an eye; a fuscous stripe present at dorsal margin of eye; second antennal segment with apical one-fourth black; basal two-thirds of corium without fuscous points at bases of hairs except one row bordering claval suture................ **brevicornis**, p. 55
   Postocular space of head little more than half lateral width of an eye; second antennal segment with a narrow fuscous area at apex; corium with three or four rows of fuscous points on basal two-thirds................... **separatus**, p. 55

Macrolophus separatus (Uhler)

Dicyphus separatus Uhler (1894, p. 194).

MALE.—Length 4.30. Head width 0.54, vertex 0.28; lateral width of an eye 0.20, space between eye and pronotal collar, 0.11; without trace of a fuscous vitta behind dorsal margin of eye. Rostrum, length 1.79, scarcely attaining posterior margins of hind coxae. First antennal segment, length 0.38, black; second, 1.17, yellowish, narrow area at apex black; third, 1.28, slender, yellowish to dusky; fourth, 0.51, fusco-brownish. Pronotum, length 0.66, width at base 1.06.

FEMALE.—Length 4.20. Head width 0.56, vertex 0.29; lateral width of an eye 0.20, space between eye and pronotal collar 0.11. First antennal segment, length 0.34; second, 1.00, practically equal to width of pronotum at base; third, 1.20; fourth 0.52.

FOOD PLANTS.—Found breeding on *Gerardia pedicularia*; also occurs in Illinois on leafcup (*Polymnia* sp.).

KNOWN DISTRIBUTION.—Florida, Illinois, Indiana, Maryland, New York, Ohio.

Illinois Records.—BLOOMINGTON: July 18, 1932, T. H. Frison, 1 ♀. CHICAGO: Aug. 4, W. J. Gerhard, 1 ♂, FM. GOLCONDA: June 22, 1932, Ross, Dozier & Park, 1 ♂. HARDIN: June 5-9, 1932, H. L. Dozier, 2 ♂, 1 ♀. KANKAKEE: Sept. 19, 1930, on *Gerardia pedicularia*, Frison & Ross, 28 ♂, 65 ♀. ST. ANNE: Aug. 4, 1936, Frison & Burks, 1 ♀. URBANA: Aug. 25, 1930, H. H. Knight, 8 ♂, 5 ♀; 1930, on *Polymnia* sp., T. H. Frison, 13 ♂, 10 ♀. ZION: July 6, 1932, T. H. Frison, 6 ♂, 5 ♀.

Macrolophus brevicornis Knight

Macrolophus brevicornis Knight (1926*i*, p. 315).

This species is suggestive of *tenuicornis* Blatchley, but the antennae are distinctly shorter, with the first segment not equal to the width of the head; it is distinguished from *separatus* (Uhler) as shown in the key.

MALE.—Length 3.60, width 0.96. Head width 0.48, vertex 0.26; lateral width of an eye 0.16, or a trifle greater than space (0.11) between eye and base of head where collar normally fits. Rostrum reaching to middle of hind coxae, length 1.34. Antennae, first segment, length 0.34, scarcely equal to width of vertex plus dorsal width of an eye; second, 0.88, being a trifle greater than width of pronotum at base, apical one-fourth black; third, 1.03; fourth, 0.43. Pronotum, length 0.54, width at base 0.84.

General coloration usually lemon yellow, sometimes greenish yellow; head with a fuscous stripe behind dorsal margin of eye; hemelytra with fuscous points more distinct than in *tenuicornis*, basal two-thirds of corium without fuscous points at bases of hairs, except one row bordering claval suture.

FEMALE.—Head width 0.47, vertex 0.25; lateral width of an eye 0.16, space between eye and pronotal collar 0.11. Antennae, first segment, length 0.33; second, 0.75, not equal to width of pronotum at base; third, 1.00;

fourth, 0.38. Pronotum, length 0.54, width at base 0.84.

FOOD PLANT.—In Iowa found breeding on an unidentified milkweed (*Asclepias* sp.).

KNOWN DISTRIBUTION. — Illinois, Iowa, Kansas, Maryland, New Jersey.

Illinois Records. — HARDIN: June 5-9, 1932, H. L. Dozier, 2 ♂, 1 ♀. VIENNA: May 18, 1932, H. L. Dozier, 3 ♀.

Macrolophus tenuicornis Blatchley

Macrolophus tenuicornis Blatchley (1926*b*, p. 913).

MALE.—Length 4.20, width 0.91. Head width 0.47, vertex 0.26; lateral width of an eye 0.17, space between eye and pronotal collar 0.13. Rostrum reaching to near posterior margin of hind coxae. Antennae, first segment, length 0.56, pale, apex black; second, 1.43, pale, apex black, length greater than basal width of pronotum plus width of head. Pronotum, length 0.60, width at base 0.78. General coloration greenish yellow, darkened with fuscous, nearly as in *separatus* (Uhler), but fuscous points on corium much fainter and confined to inner half; longitudinal fuscous stripe behind dorsal margin of each eye.

FEMALE.—Length 4.00, width 1.00. Head width 0.43, vertex 0.26. Antennae, first segment, length 0.47; second, 1.17. Pronotum, length 0.60, width at base 0.82. Very similar to male in form and coloration.

FOOD PLANT.—Leafcup (*Polymnia canadensis*).

KNOWN DISTRIBUTION.—Illinois and Indiana.

Illinois Records.—ALGONQUIN: Aug. 7, 1930, on *Polymnia canadensis*, Frison & Knight, 1 ♂. FERN CLIFF: Aug. 3, 1934, DeLong & Mohr, 1 ♂, 3 ♀. GOLCONDA: July 25, 1930, on *Polymnia canadensis*, Knight & Ross, 52 ♂, 5 ♀. MORRIS: July 19, 1883, Webster, 1 ♂. URBANA: 1930, on *Polymnia* sp., T. H. Frison, 1 ♂, 1 ♀.

Hyaliodes Reuter

KEY TO SPECIES

1. Collar, calli and areas lateral to calli very dark brown or black, median pronotal line always light, fig. 98; length of first antennal segment of male equal to maximum width of pronotum; length of first antennal segment of female four-fifths as great as maximum width of pronotum................**harti,** p. 57

   Entire pronotum almost colorless; or pronotum with collar, calli, and a broad median mark extending from anterior to posterior margins, dark brown or black; or pronotum with a vague dark mark on median line at posterior margin; length of first antennal segment in either ex not more than three-fourths as great as maximum width of pronotum..... 2

2. Broad, median, dark brown or black mark extending from anterior to posterior margins of pronotum.... **vitripennis** var. **discoidalis,** p. 56

   Pronotum without broad, median, longitudinal, dark mark.......... 3

3. Length of first antennal segment equal to or only slightly greater than width of head measured across eyes.................**brevis,** p. 58

   Length of first antennal segment much greater than width of head across eyes; at least two-thirds as great as maximum width of pronotum..... **vitripennis** var. **vitripennis,** p. 56

Hyaliodes vitripennis (Say)

Capsus vitripennis Say (1832, p. 24).

Length 4.80, width 1.70; hemelytra hyaline, glassy, with black or red marks bordering scutellum, inner edge of clavus and corium, and extending across apex of corium to lateral margin; also dark on membrane, veins and tip of cuneus; pronotum usually almost entirely colorless; antennae variously marked with red.

In some specimens the median area of the posterior portion of the pronotum tends to be fuscous; in others it may be dark brown or black. Other specimens may have this dark mesal area extending the full length of the pronotum. These dark extremes constitute the variety *discoidalis* Reuter (1909, p. 61).

HABITS.—Occurs on several plants; frequent on grape (*Vitis* sp.); predacious on plant lice.

KNOWN DISTRIBUTION. — Originally described from Indiana and Pennsylvania and since recorded from several eastern states and southern Canada.

Illinois Records.—Forty-eight males and 95 females, taken May 24 to Sept. 10, are

from Alton, Antioch, Ashley, Bluff, Cairo, Clay City, Danville, Darwin, De Soto, Dolson, Dongola, Dubois, Eichorn, Elizabethtown, Evanston, Fairfield, Fort Sheridan, Galesburg, Grantsburg, Hardin, Harrisburg, Havana, Herod, Kampsville, Karnak, Marshall, McHenry, Meredosia, Metropolis, Monticello, Olive Branch, Oregon, Parker, Pulaski, Quincy, Rock Island, Shawneetown, Starved Rock State Park, Urbana, West Pullman, White Heath, Willow Springs, Zion.

Hyaliodes harti new species

This is distinguished from *vitripennis* (Say) by the longer first antennal segment,

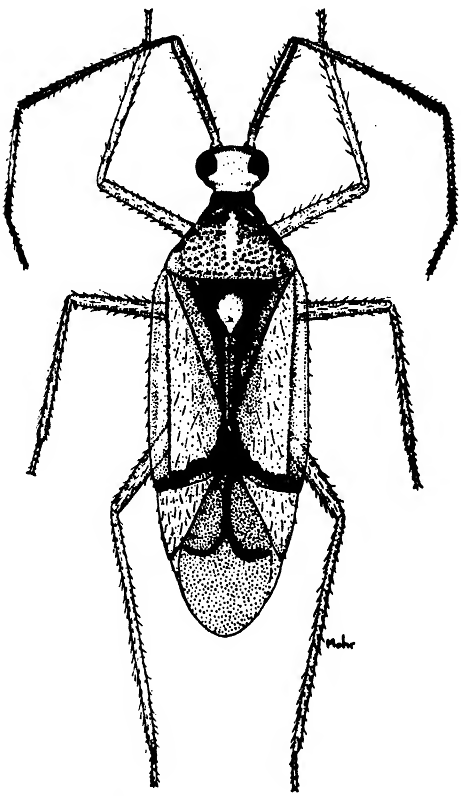


Fig. 98.—*Hyaliodes harti.*

which, in the male, is equal to the width of the pronotum at base.

MALE.—Length 4.40, width 1.40. Head, width 0.73, vertex 0.26. Rostrum just attaining posterior margins of middle coxae, length 1.20. Antennae, first segment, length 1.10, bright red; second, 1.69, reddish to black; third, 1.12, black; fourth, 0.60. Pronotum, length 0.82, width at base 1.12. General color pale, translucent; head and body yellowish; calli, collar, scutellum except apex, mesoscutum, and inner margin of clavus, black; apex of scutellum white; apex of corium, and tip of embolium, red; cuneus and membrane clear, anal angles fuscous, veins red to fuscous. Legs pale to yellowish.

FEMALE.—Fig. 98. Length 4.90, width 1.60. Head width 0.71, vertex 0.32. Antennae, first segment, length 1.08; second, 1.77. Pronotum, width at base 1.34. Very similar to male in form and coloration.

Holotype, male. —Harrisburg, Ill.: June 25, 1932, Ross, Dozier & Park.

Allotype, female.—Same data as for holotype.

Paratypes. — ILLINOIS. — Same data as for holotype, 11 ♂, 3 ♀. NORTHERN ILLINOIS: 1 ♂, 3 ♀. ALTON: July 19-21, 1932, Ross & Dozier, 1 ♀. ANNA: June 27, 1909, 2 ♀. ASHLEY: Aug. 7, 1917, 3 ♂, 3 ♀. BEVERLY HILLS: Sept. 11, 1907, E. B. Chope, 1 ♀; July 13, 1908, W. J. Gerhard, 1 ♂. DIXON SPRINGS: June 23, 1932, Ross, Dozier & Park, 1 ♂. DOLSON: Sept. 30, 1935, T. H. Frison, 1 ♀. DUBOIS: July 2, 1909, 2 ♂. EICHORN: June 24, 1932, Hick's Branch, on *Alnus rugosa*, Ross, Dozier & Park, 1 ♂. ELIZABETHTOWN: June 22-24, 1932, Ross, Dozier & Park, 1 ♂; July 8, 1935, Ross & DeLong, 2 ♀. GALENA: June 30, 1932, Dozier & Mohr, 1 ♀. GALESBURG: July 24, 1892, Stromberg, 2 ♂, 2 ♀. GEFF: June 12, 1934, DeLong & Ross, 1 ♀. GLENVIEW: July 19, 1931, A. R. Park, 1 ♀. HEROD: June 23, 1927, T. H. Frison, 1 ♂; June 24, 1932, Ross, Dozier & Park, 1 ♀. JOLIET: July 31, 1930, Frison & Knight, 2 ♀. KARNAK: June 23, 1932, Ross, Dozier & Park, 1 ♀. LA GRANGE: Sept. 11, 1907, 1 ♂. LA RUE: July 11, 1935, DeLong & Ross, 1 ♂, 1 ♀. LAWRENCEVILLE: Sept. 7, 1933, Ross & Mohr, 1 ♀. MAKANDA: June 26, 1909, 1 ♂. MARSHALL: July 23, 1932, Dozier & Park, 1 ♂. METROPOLIS: Aug. 20, 1916, 1 ♀. MONTICELLO: June 28, 1914, 1 ♀. NORMAL: July 22, 1884, on black walnut, 1 ♀; July 26, 1884, on leaves of maple, 1 ♀. OAKWOOD: July 22, 1930, Hottes & Tauber, 1 ♀; Oct. 6, 1930, T. H. Frison, 1 ♀. OLIVE BRANCH: Oct. 2, 1909, W. J. Gerhard, 1 ♂. QUINCY: Aug. 14, 1889, "sweeping along shore of Mississippi R.," C. A. Hart, 1 ♀. ROCKFORD: July, 1932, Dozier & Mohr, 1 ♀. ROCK ISLAND: July 7, 1934, DeLong & Ross, 1 ♂. ST.

ANNE: July 22, 1935, Ross & DeLong, 1 ♀. SPRINGFIELD: July 12, 1932, T. H. Frison, on *Quercus* sp., 3 ♂, 7 ♀. STARVED ROCK STATE PARK: July 14, 1932, Dozier & Park, 5 ♂, 16 ♀. TAMAROA: Sept. 22, 1882, 1 ♀. TEMPLE HILL: June 24, 1936, DeLong & Ross, 1 ♂, 2 ♀. URBANA: Sept. 27, 1892, C. A. Hart, 1 ♀; July 21, 1889, "sweeping in Univ. forestry," C. A. Hart, 1 ♀; Oct. 8, 1889, in woods, Marten, 1 ♀; June 23, 1908, 1 ♀; Aug. 23, 1917, 1 ♀; Aug. 11, 1932, Knight & Ross, 1 ♂, 1 ♀; Sept., 1932, T. H. Frison, 1 ♂. WARREN: Aug. 22, 1935, DeLong & Ross, 1 ♂. WHITE HEATH: July 11, 1915, 1 ♀; July 4, 1933, H. H. Ross, 1 ♂. WILLOW SPRINGS: June 27, 1905, A. B. Wolcott, 1 ♂.

GEORGIA.—EXPERIMENT: Aug. 6, 1929, T. L. Bissell, 1 ♂.

IOWA.—AMES: July 31, 1 ♀; Aug. 1, 1932, F. Andre, 1 ♀.

MISSOURI.—SPRINGFIELD: July 18, 1915, H. H. Knight, 4 ♀.

NEW YORK.—BATAVIA: July 30, 1916, H. H. Knight, 2 ♂. ITHACA: July 23, 1 ♀; July 26, 1916, H. H. Knight, 2 ♂.

NORTH CAROLINA.—RALEIGH: July, 1909, F. Sherman, 1 ♂.

NORTH DAKOTA.—DICKENSON COUNTY: July 23, 1925, E. D. Ball, 1 ♀. TRAIL COUNTY: July 19, 1923, A. A. Nichol, 1 ♀.

ONTARIO.—PARRY SOUND: Aug. 7, 1915, H. S. Parish, 1 ♂, 2 ♀.

WISCONSIN.—HAYWARD: Aug. 15, 1932, Moose Lake, T. H. Frison, 1 ♂.

Hyaliodes brevis new species

This species is distinguished by its short first antennal segment which, in the female, does not exceed the width of the head across the eyes and, in the male, exceeds the width of the head only very slightly; the body is shorter and more nearly ovate than in *vitripennis* (Say).

MALE.—Length 4.00, width 1.80. Head width 0.69, vertex 0.32. Rostrum scarcely reaching base of middle coxae, length 0.95. Antennae, first segment, length 0.70, pale yellowish, becoming reddish at apex; second, 1.43, fuscous to black, slightly paler at middle; third, 0.74; fourth, 0.26, black. Pronotum, length 0.86, width at base 1.16. General color pale to yellowish; scutellum white; hemelytra clear, translucent; tip of cuneus, veins in membrane, narrow inner margin of clavus, narrow band across apex of corium, and tip of embolium, fuscous to black. Legs and ventral surface pale, apex of hind femora becoming reddish.

FEMALE.—Length 4.00, width 1.55. Head width 0.69, vertex 0.31. First antennal segment, length 0.65, scarcely equal to width of head. Pronotum, length 0.86, width at base 1.20. Very similar to male but black areas much reduced, apex of corium and tip of cuneus still retaining black.

Holotype, male. — URBANA, ILL., Aug. 10, 1932, on bur oak, *Quercus macrocarpa*, H. H. Knight.

Allotype, female. — Same data as for holotype.

Paratypes. — ILLINOIS. — Same data as for holotype, 11 ♂, 22 ♀. STARVED ROCK STATE PARK: July 14, 1932, Dozier & Park, 1 ♂, 5 ♀. URBANA: Aug. 3, 1932, H. H. Ross, 1 ♂; Aug. 10, 1932, H. H. Ross, 5 ♂, 3 ♀; Aug. 11, 1932, H. H. Ross, 1 ♂, 2 ♀, H. H. Knight, 4 ♂, 6 ♀.

IOWA.—AMES: Aug. 1, 1 ♀; Aug. 9, 1932, F. Andre, 2 ♂.

MINNESOTA.—ST. ANTHONY PARK: Aug. 5, 1920, H. H. Knight, 1 ♀.

BRYOCORINAE

KEY TO GENERA

1. Pronotum with a distinct collar and not gibbous posteriorly; sparsely punctured, figs. 73, 99 .... **Monalocoris**, p. 58
   Pronotum without a distinct collar, and posteriorly inflated and enlarged, often very much so; coarsely punctured, figs. 100, 101 2
2. Pronotum posteriorly greatly inflated, with a longitudinal crease at least in middle; embolium broadly expanded and flat, not thickened, fig. 101 .... **Pycnoderes**, p. 60
   Pronotum posteriorly moderately inflated, without longitudinal impressions; embolium narrow, thickened, fig. 100..... **Sixeonotus**, p. 59

Monalocoris Dahlbom

Monalocoris filicis (Linnaeus)

Cimex filicis Linnaeus (1758, p. 443).

ADULT.—Fig. 99. Length 2.50, width 1.40; short oval, convex. General color brown to dark brown, shining. Pronotum

finely punctured; legs and antennae pale yellowish brown.

HOST PLANTS.—Occurs on shield fern (*Aspidium spinulosum*) and cinnamon fern (*Osmunda cinnamonea*).

KNOWN DISTRIBUTION.—A European species known also from Canada, Florida, Illinois, Minnesota, New England states, Wisconsin.

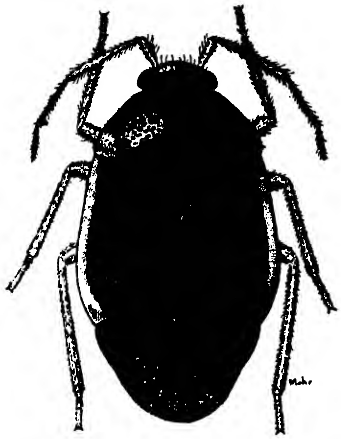


Fig. 99.—*Monalocoris filicis*, ♀.

Illinois Records.—ANTIOCH: Aug. 1, 1924, tamarack bog, T. H. Frison, 2 ♀; Aug. 1, 1930, on *Osmunda cinnamonea*, Frison, Knight & Ross, 49 ♂, 50 ♀; July 5-7, 1932, T. H. Frison, 2 ♀. GALENA JUNCTION: July 8, 1917, 1 ♀. VOLO: July 8, 1932, Ross, Dozier & Mohr, 1 ♀; Aug. 24, 1935, DeLong & Ross, 1 ♂.

Sixeonotus Reuter

KEY TO SPECIES

1. Legs black; membrane uniformly fuscous to black. . . . **unicolor,** p. 59
   Legs entirely pale with brownish areas on hind femora. 2
2. Antennae and legs uniformly pale; membrane with basal half black. . . . . **insignis,** p. 59
   Antennae black; hind femora and basal halves of tibiae fuscous; membrane pale, veins black. . . . . **areolatus,** p. 60

Sixeonotus insignis Reuter

Sixeonotus insignis Reuter (1876, p. 78).

ADULT.—Fig. 100. Length 3.10, width 1.50. Head width 0.73, vertex 0.43. Rostrum reaching to middle of sternum. First antennal segment, length 0.25; second, 0.54. Pronotum, length 0.86, width at base 1.30. General color black; legs and antennae very light yellowish; membrane black, apical half pale, veins black.

KNOWN DISTRIBUTION.—Texas eastward to Florida, north to Virginia and west to Illinois.

Illinois Records.—ALTON: July 19-21, 1932, Ross & Dozier, 1 ♀. CHAMPAIGN: July 26, 1889, electric light, C. A. Hart, 1 ♂. DONGOLA: Aug. 22, 1916, at light, 1 ♀. GALESBURG: Stromberg, 1 ♂. HAVANA: Sept. 24, 1895, Matanzas Lake, C. A. Hart, 2 ♂, 1 ♀; July 2, 1934, DeLong & Ross, 1 ♀. METROPOLIS: Aug. 20, 1916, at light, 2 ♀. PULASKI: May 14, 1910, cypress swamp, 1 ♀. WOLF LAKE: July 30, 1934, DeLong & Ross, 1 ♀.

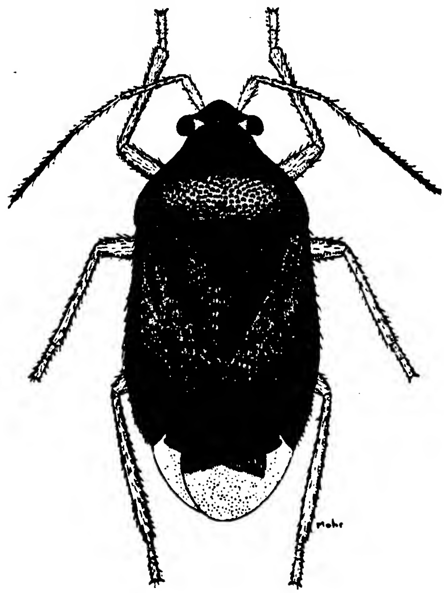


Fig. 100.—*Sixeonotus insignis*, ♀.

Sixeonotus unicolor Knight

Sixeonotus unicolor Knight (1929*a*, p. 247).

This species may be distinguished by being uniformly black, including the membrane; the pubescence is prominent, erect and white.

MALE.—Length 3.20, width 1.48. Head width 0.75, vertex 0.47. Rostrum extending slightly beyond middle of sternum, black; length 0.65. Antennae, first segment, length

0.26; second, 0.56; black. Pronotum, length 0.89, width at base 1.30; basal margin very slightly sinuate along middle, obscuring base of scutellum; disk moderately and evenly convex, coarsely and closely punctate, shining. Scutellum coarsely punctate, apical area rather distinctly convex and with finer punctures. Uniformly black, trochanters somewhat pale; membrane uniformly dark fuscous or black; veins black. Clothed with prominent, erect, stiff, white pubescence.

FEMALE.—Length 2.90, width 1.48. Head width 0.73, vertex 0.47. Antennae, first segment, length 0.25; second, 0.53. Pronotum, length 0.90, width at base 1.27. Very similar to male in form, punctation and pubescence, but generally slightly darker in color.

KNOWN DISTRIBUTION. — Originally described from Mississippi. Now known also from Illinois.

Illinois Records. — GALESBURG: Sept., Stromberg, 1 ♂ ; Aug. 29, 1888, Stromberg, 1 ♀.

Sixeonotus areolatus Knight

Sixeonotus areolatus Knight (1929*a*, p. 243).

Not as yet taken in Illinois; known from Alabama, Arkansas, Mississippi, Texas.

Pycnoderes Guerin

KEY TO SPECIES

1. Legs black; tibiae paler apically; embolium with large pale spot near base and a slightly smaller one near apex. .... **convexicollis**, p. 60
   Legs pale; hind femora fuscous on apical half only 2
2. Emboliar margins strongly arcuate; a large pale spot on basal half of embolium, apical half black .... **drakei**, p. 61
   Emboliar margins very slightly arcuate; embolium with small pale spot near base and also near apex, fig. 101 .... **medius**, p. 60

Pycnoderes convexicollis Blatchley

Pycnoderes convexicollis Blatchley (1926*a*, p. 166).

This is allied to *medius* Knight, but is larger, with the pronotum more strongly gibbous; the femora are all black except at the bases, and the tibiae are very dark brown or nearly black, and with the apices almost white.

MALE.—Length 3.40, width 1.50. Head width 0.67, vertex 0.39; front partly yellowish brown. Rostrum just reaching posterior margins of middle coxae. Antennae, first segment, length 0.30; second, 0.65; third, 0.56; fourth, 0.61; pale yellowish, last two segments fuscous. Pronotum, length 1.04, width at base 1.25, height from basal angle 0.65; disk clothed with distinct white hairs, emboliar margins strongly arcuate, edge sharp; basal one-third with large translucent white spot, a small one just before apex; cuneus clear. Membrane lightly infuscated; veins black.

KNOWN DISTRIBUTION.—Described from Indiana. Now known also from Illinois.

Illinois Records.—MARSHALL: Sept. 27, 1934, Frison & Ross, 1 ♂. URBANA: July 4, 1938, 1 ♂ ; Aug. 15, 1936, Sarah Jones, 1 ♂, KC.

Pycnoderes medius Knight

Pycnoderes medius Knight (1926*e*, p. 105).

This is allied to *dilatatus* Reuter, but differs in its smaller size, fuscous membrane and broader, more heavily gibbous, bilobed pronotal disk, fig. 101; it differs from *quadrimaculatus* Guerin and *incurvus* (Dis-

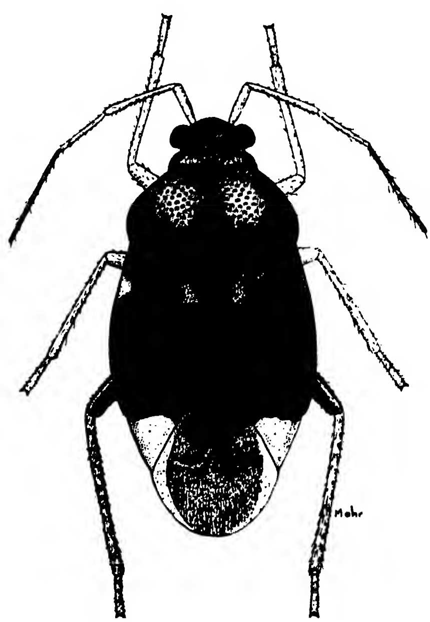


Fig. 101.—*Pycnoderes medius*, ♀.

tant) by the sharp outer edge of its embolium.

MALE.—Length 2.90, width 1.37. Head width 0.63, vertex 0.37. General color black; juga and lora more brownish. Rostrum, reaching hind margin of mesosternum, length 0.67. Antennae, first segment, length 0.27; second, 0.60; third, 0.57; fourth, 0.68; first three segments pale, fourth fuscous. Pronotum, length 0.86, width at base 1.20, height from basal angle 0.53. Punctation, pubescence and coloration nearly as in *dilatatus*, but hemelytra not so broadly dilated; apical pale spot on embolium sometimes nearly obsolete. Membrane and veins distinctly fuscous, darker at base and on veins, apical margins paler and more brownish. Legs pale; front coxae except apex, and apical half of femora, fuscous to black.

FEMALE.—Fig. 101. Length 2.80, width 1.36; similar to male in form and coloration.

KNOWN DISTRIBUTION.—Described from the Ozarks of Missouri, and now found in southern Illinois.

Illinois Records.—ALTON: July 19-21, 1932, Ross & Dozier, 1 ♂; June 27, 1934, DeLong & Ross, 1 ♂. ELIZABETHTOWN: May 22-24, 1932, Ross, Dozier & Park, 1 ♀.

Pycnoderes drakei Knight

Pycnoderes drakei Knight (1926*e*, p. 106).

Not yet collected in Illinois; known only from Mississippi.

CYLAPINAE

Represented in Illinois by two tribes, the Cylapini and Fulviini keyed out on pp. 19 and 20.

CYLAPINI

Cylapus Say

Cylapus tenuicornis Say

Cylapus tenuicornis Say (1832, p. 26).

ADULTS.—Length 5.50–6.00, width 2.20. General color brownish gray, marked with white. Distinguished by the long, slender antennae and prominent, protuberant eyes.

HABITS.—This is a very active species, usually to be found on dead and fungus-covered tree trunks.

KNOWN DISTRIBUTION.—Originally described from Indiana, and since recorded from Illinois, Maryland, New York, Pennsylvania, Ontario, Virginia.

Illinois Records.—MOUNT CARMEL: June 30, 1906, 1 ♂. OREGON: July 9, 1925, T. H. Frison, 1 ♂. SAVANNA: July 29, 1892, base of bluff, 1 ♀.

FULVIINI

KEY TO GENERA

Tarsi three-segmented; lateral margins of pronotum rounded near anterior angles, not shelflike, fig. 68......**Fulvius**, p. 61

Tarsi two-segmented; lateral margins of pronotum sharp and shelflike for their entire length, fig. 102...**Peritropis**, p. 62

Fulvius Stål

KEY TO SPECIES

Second antennal segment uniformly pale yellow; scutellum brown with a pale spot at apex................**brunneus**, p. 61

Second antennal segment brown, white at apex; scutellum uniformly brown...... ....**imbecilis**, p. 61

Fulvius brunneus (Provancher)

Lygus brunneus Provancher (1872, p. 104).

ADULTS.—Length 3.40, width 1.10. General color brown, marked with yellowish and white. Second antennal segment pale yellowish; femora brown like pronotum, basal half of cuneus white; apex of scutellum and an area on hemelytra pale.

KNOWN DISTRIBUTION.—Originally described from Ontario, and since reported from Colorado, District of Columbia, Illinois, Iowa, Kansas, Massachusetts, Virginia.

Illinois Records.—OLIVE BRANCH: Sept. 29, 1909, W. J. Gerhard, 1 ♀, FM. WEST PULLMAN: July 13, 1902, W. J. Gerhard, 1 ♂; Oct. 27, 1912, A. B. Wolcott, 1 ♀, FM. WILLOW SPRINGS: Aug. 4, 1912, W. J. Gerhard, 1 ♀, FM.

Fulvius imbecilis (Say)

Capsus imbecilis Say (1832, p. 25).

ADULTS.—Length 4.00, width 1.20. Very similar to *brunneus* (Provancher), but larger. Second antennal segment brown with apical third white; femora yellowish brown; scutellum dark brown.

KNOWN DISTRIBUTION.—Described from Indiana and since reported from Alabama, Florida, Illinois, Minnesota, Missouri, North Carolina, Pennsylvania, Tennessee.

Illinois Records.—BEVERLY HILLS: Aug. 27, 1908, W. J. Gerhard, 1 ♂. CARBONDALE: Aug. 21, 1891, Hart & Shiga, 1 nymph. DUBOIS: June 21, 1905, 1 ♀. GALESBURG: Sept., Stromberg, 1 ♂, 1 ♀. HAVANA: Aug. 16, 1883, 1 nymph. MOUNT CARMEL: June 30, 1906, 2 ♂. OLIVE BRANCH: Sept. 29, 1909, W. J. Gerhard, 1 ♀, FM. URBANA: June 16, 1887, electric light, C. A. Hart, 1 ♀. WHITE HEATH: June 25, 1916, 1 ♂.

Peritropis Uhler

KEY TO SPECIES

Coxae brown; clavus and corium thickly dotted with pale flecks..... **husseyi,** p. 62

Coxae pallid; clavus and corium brown to fuscous, without pallid flecks........ .... **saldaeformis,** p. 62

Peritropis saldaeformis Uhler

Peritropis saldaeformis Uhler (1891, p. 122).
Peritropis saldiformis Bergroth (1920, p. 74). *Emended name.*

Diagnostic color characters: general color brownish black, alutaceous, head and pronotum thickly dotted with pale yellowish, clavus and corium unspotted, coxae pallid.

FEMALE.—Length 2.90, width 1.51. Head width 0.65, vertex 0.32, length from front margin of eyes to tip of tylus 0.28. Rostrum, length 1.51, reaching to base of sixth ventral segment. Antennae, first segment, length 0.22, brown, a white annulus on basal half, a pallid dot on dorsal aspect of apical half; second, 0.88, dark brown, a white spot at middle on dorsal side, somewhat paler near base. Pronotum, length along median line 0.49, width at base 1.29, anterior width 0.45; lateral margins nearly straight, shelflike, very slightly reflexed; basal margin with small tubercle at median line, each side of this a distinct scallop, then sinuate to basal angle, the basal edge whitish; calli strongly convex, separated at median line by a foveate depression. Scutellum moderately convex, dark brown, apex white; mesoscutum broadly exposed for a longitudinal space equal to three-fourths the length of scutellum. Sternum and pleura dark brown, a white spot on mesepimeron. Hemelytra dark brown to blackish, a few white dots on costal edge of embolium; width 1.50; emboliar margins very slightly arcuate, moderately reflexed; cuneus triangular, narrow white area at apex and at inner basal angle. Membrane and veins uniformly pale brown. Legs brownish black; coxae pallid to white; tibiae with three white spots on basal half, apical one-third pallid; tarsi pale fuscous. Venter dark brown.

MALE.—Length 3.20, width 1.47; somewhat more slender than the female but very similar in color. Head width 0.60, vertex 0.29. Rostrum, length 1.60, reaching upon seventh abdominal sternite. Antennae, first segment, length 0.19; second, 1.12. Pronotum, length 0.47, width at base 1.21.

KNOWN DISTRIBUTION.—Described from the District of Columbia and Illinois. Uhler states: "Others have been captured near Chicago and in other parts of northern Illinois." Known from District of Columbia, Illinois, Iowa, Maryland, Oklahoma, Pennsylvania and Texas. The only record for Illinois is that in the original description.

Peritropis husseyi Knight

Peritropis husseyi Knight (1923*a*, p. 50).

FEMALE.—Fig. 102. Length 3.20. Head width 0.62, vertex 0.31, length from front margin of eyes to tip of tylus 0.31; front

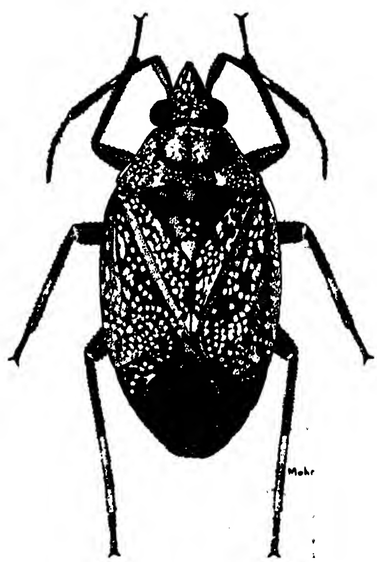


Fig. 102.—*Peritropis husseyi.*

more porrect and more nearly cone shaped than in *saldaeformis* Uhler. General color brownish black, irregularly marked with small pale spots; three or four larger spots on the strongly flattened tylus; bucculae tinged reddish. Rostrum brownish black, length 2.22, nearly attaining the hind margin of the first genital segment. Antennae, first segment, length 0.28, black; second, 1.00, nearly cylindrical, but slightly thickened toward apex, black, a small pallid spot on dorsal side near middle, the extreme tip slightly paler, clothed with very fine, short, pale pubescence; third, 0.29; fourth, 0.34; last two segments slender, black. Pronotum brownish black; length along median line 0.51, width at base 1.17; anterior width 0.61; lateral margins practically straight, shelflike, extreme edge reflexed; anterior angles prominent, forming right angles; basal margin with a broad sulcus which rounds distally; margin without tubercles, practically transverse on the middle one-third; calli less prominent than, and not so abruptly convex as, in *saldaeformis*, separated by a foveate groove at the median line of disk; disk rather closely dotted with whitish spots that are frequently confluent; slender area at lower margin of propleura, and a line extending distad from the top of coxal cleft, pallid. Scutellum nearly as in *saldaeformis*, more extensively white at apex, a few pale dots adjoining; mesoscutum exposed for a longitudinal space equal to two-thirds the length of scutellum, a curved pale mark near each basal angle. Sternum and pleura brownish black; basalar plate, and posterior and ventral margins of epimera, pale; ostiolar peritreme pallid.

Hemelytra brownish black, rather closely spotted with pallid, the spots frequently elongate or confluent, each pale point with a minute, short, scalelike hair; tip of clavus and spot at inner basal angle of cuneus rendered pallid by the fusion of several small points; cuneus black, a few pale points near base; width 1.54, emboliar margins arcuate, somewhat reflexed basally. Membrane uniformly pale fuscous, the veins scarcely darker, slightly paler areas bordering margin of cuneus. Legs brownish black; coxae scarcely paler at apices; middle and hind tibiae paler apically, a narrow pallid annulus near middle; front and middle tarsi pale fuscous, hind pair lighter. Venter brownish black, with pale yellowish pubescence.

MALE.—Length 3.00, width 1.40; slightly smaller than the female but very similar in structure and color; genital claspers prominent and distinctive.

HABITS.—Collected by R. F. Hussey from beneath bark of white oak logs cut for fence posts.

KNOWN DISTRIBUTION. — Alabama, Illinois and Michigan.

Illinois Record.—MEREDOSIA: Aug. 21, 1917, sand pit, 1 ♀.

CLIVINEMINAE

Represented in Illinois by two tribes, the Largideini and Clivinemini, keyed out on p. 20.

LARGIDEINI

Largidea Van Duzee

Largidea grossa Van Duzee

Largidea grossa Van Duzee (1916*c*, p. 238).

This species is allied to *davisi* Knight, but is distinguished by the thick, more inflated form of its second antennal segment.

FEMALE.—Length 5.30, width 2.60. Head width 1.34, vertex 0.86. Rostrum extending slightly beyond middle of sternum, length 1.50. Antennae, first segment, length 0.35, thickness 0.17; second segment, 1.73, strongly inflated, thickness 0.30 at middle, tapering off at either end. Pronotum, length 1.60, width at base 2.20, disk moderately convex, with coarse, rugulose punctation. Scutellum moderately convex, finely punctate. Clavus and corium with shallow, rugulose punctation. Clothed with short, recumbent, pale to dusky pubescence. General color reddish brown, calli black, membrane fuscous, veins darker.

KNOWN DISTRIBUTION. — Originally described from Lake Tahoe, California, and later found in Oregon and the Santa Catalina Mountains of Arizona. It occurs on pines.

Illinois Record.—A single female specimen in the Illinois Natural History Survey collection bears the data, "Havana, Ill., Sept. 21, 1895, at lights in town, collected by Hempel." This specimen can be identified only as *Largidea grossa,* although this species has always been considered to be restricted to the far western states. This surprising distribution record cannot at the present time be explained.

CLIVINEMINI

KEY TO GENERA

Membrane distinctly pubescent; collar not distinctly hooded over head .... **Bothynotus**, p. 64
Membrane glabrous, or with extremely fine pubescence only; collar hooded or somewhat elevated above head .... **Clivinema**, p. 64

Clivinema Reuter

No Illinois species; *Clivinema villosa* Reuter occurs in Montana, Oklahoma, Texas.

Bothynotus Fieber

Bothynotus modestus (Wirtner)

Neobothynotus modestus Wirtner (1917, p. 34).

This species is distinguished from the other known American species by its large size and longer antennae; also, the length of the second antennal segment is much greater than the width of the head.

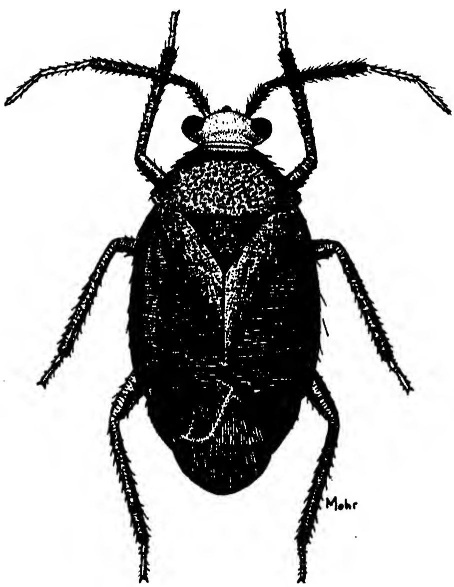


Fig. 103.—*Bothynotus modestus*, ♂.

MALE.—Fig. 103. Length 5.10, width 2.40. Head width 0.99, vertex 0.56. Rostrum reaching to bases of hind coxae, length 1.60. Antennae, first segment, length 0.49, fusco-brownish, strongly pubescent; second segment, 1.50, black, cylindrical, equal in thickness to first segment, thickly clothed with suberect pubescence; third, 0.69, slender, pale to dusky, clothed with long pubescence; fourth, 0.35, slender, fuscous. Pronotum, length 1.30, width at base 1.90; disk convex, coarsely and closely punctate, clothed with long fuscous pubescence. Scutellum strongly convex, impunctate, pubescent. Hemelytra with emboliar margins subparallel, with sharp edge, clavus and corium strongly, transversely rugulose; membrane and veins uniformly dark fuscous, thickly clothed with erect fuscous pubescence. Body black, distinctly shining, head red, tylus black, legs very dark brown, tibiae somewhat paler and translucent.

FEMALE.—Length 4.80, width 2.60; emboliar margins distinctly arcuate. Head width 1.01, vertex 0.65. Antennae, first segment, length 0.51; second, 1.20, more slender than first segment, black, paler on basal half, clothed with long pubescence; third, 0.73; fourth, 0.56. More robust than male, but similar in color and pubescence.

KNOWN DISTRIBUTION.—Described from Pennsylvania, where it was found on pine trees. Single specimens are now known from Illinois, Kansas, Maryland, Ohio. Apparently this is a rare but widely distributed species.

Illinois Record.—NORTHERN ILLINOIS: 1 ♀.

DERAEOCORINAE

KEY TO GENERA

1. Second antennal segment broad and distinctly flattened, fig. 20 .... **Hesperophylum**, p. 74
   Second antennal segment cylindrical, fig. 105 2
2. Antennae linear, very long and of nearly equal thickness throughout, fig. 105; vertex transversely striate and longitudinally sulcate, fig. 104; second segment of hind tarsus much shorter than either first or third segments; usually large, elongate species .... **Eustictus**, p. 65
   Antennae not so long or linear, second segment slender at base and slightly enlarged toward apex, third segment slender, fig. 107; vertex usually polished; second segment of hind tarsus

as long as either first or third segments, or nearly so 3

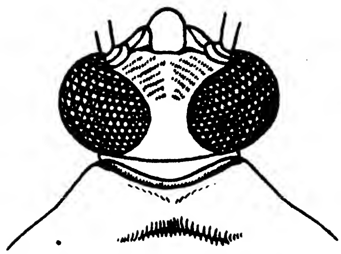


Fig. 104.—Head and pronotum of *Eustictus salicicola.*

3. Head strongly produced and nearly horizontal, facial angle acute, tylus projecting beyond apex of first antennal segment, fig. 108; emboliar margin thin and broadly expanded, sides nearly parallel . . . . **Eurychilopterella,** p. 73

   Head less produced, scarcely surpassing middle of first antennal segment, fig. 107, facial angle either one of 90 degrees or only slightly less; embolium not as above . . . . **Deraeocoris,** p. 66

Eustictus Reuter

KEY TO SPECIES

1. Hind tibiae with long, fine hairs on basal half, these hairs distinctly longer than true spines 2

   Hind tibiae with minute pubescence on basal half, these hairs not so long as true spines 3

2. Pronotal disk uniformly very dark brown; legs chiefly reddish, tibiae without paler bands; length 8.00–11.00 . . . . **filicornis,** p. 66

   Pronotal disk black, but paler near basal margin; legs pale testaceous and marked with black, tibiae distinctly marked with four alternating pale and fuscous bands . . . . **venatorius,** p. 66

3. Pronotal disk with median portion black; broad, pale areas with dark punctures present at lateral margins; width of vertex of male only slightly greater than thickness of first antennal segment; length, male 6.90, female 7.40 . . . . **salicicola,** p. 65

   Pronotal disk chiefly dark brown, not paler at lateral margins; width of vertex of male twice as great as thickness of first antennal segment; length, male 5.50–6.00, female 7.00 . . . . **necopinus,** p. 66

Eustictus salicicola Knight

Eustictus salicicola Knight (1923*d*, p. 482).

This is allied to *venatorius* Van Duzee, but differs in the form of its antennae, its tibial pubescence and the color pattern of the dorsum.

MALE.—Fig. 105. Length 6.90, width 2.40. Head width 1.19, vertex 0.08, height of eye 0.77; eyes prominent, projecting above

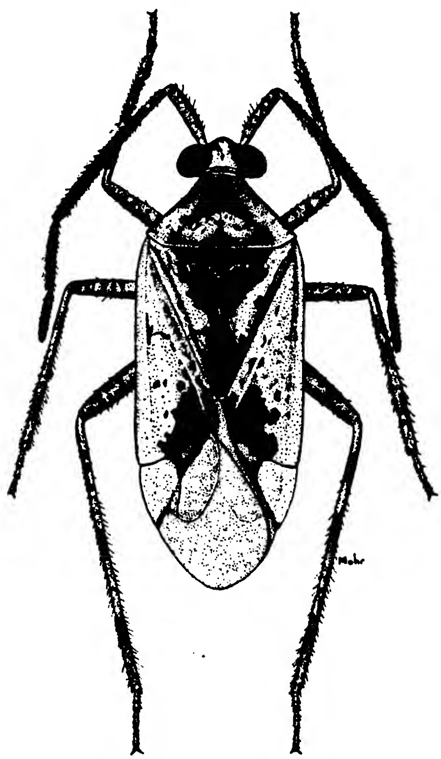


Fig. 105.—*Eustictus salicicola,* ♂.

vertex and below gula. Rostrum, length 2.77, attaining posterior margins of hind coxae. Antennae, first segment, length 0.81, pale, marked with black; second, 2.31, dark fuscous, paler on basal one-sixth but with faint dark spots, extreme apex paler, rather densely covered with fine, short, pale pubescence, a few hairs slightly longer, but none exceeding thickness of segment; third, 1.05, black, paler apically; fourth, 0.91, black. Pronotum, length 1.25, width at base 2.00;

median portion of disk black, broad pale areas with dark punctures present at lateral margins; propleura very dark brown, lower margins pale. Scutellum black, basal angles paler; minutely, sparsely pubescent. Hemelytra glabrous, pale, translucent and marked with fuscous, but without large spots on basal half as in *venatorius*; clavus black on either side of commissure, slender dark markings bordering claval veins; corium with punctures; radius, and large spot on inner apical angle, dark fuscous to black; embolium scarcely darkened at apex, extreme outer edge black, width 2.50. Cuneus pale, translucent, inner apical margin blackish. Membrane pale, smoky within areoles, veins slightly darker, a fuscous mark bordering apical margin of larger areole. Legs pale and marked with black; femora with apical half marked and spotted with black, an irregular pale but spotted subapical annulus; tibiae with four paler bands but more or less interrupted with dark spots, pubescence short, not attaining length of true spines. Venter pale greenish with reddish marks.

FEMALE.—Length 7.40, width 2.77; very similar to male in coloration, but differs in pilose character of antennae.

HABITS.—This species occurs on the bark of willow trees where it may be predacious on aphids and other small insects.

KNOWN DISTRIBUTION. — Illinois, Iowa, Kansas, Minnesota, Mississippi, Nebraska, Oklahoma, South Dakota, Texas.

Illinois Records.—Five males and 8 females, taken June 17 to Sept. 7, are from Alton, Chicago, Galesburg, Havana, Lawrenceville, Metropolis, Mount Carmel, Rosiclare, Savanna.

Eustictus filicornis (Walker)

Capsus filicornis Walker (1873, p. 96).
Megacoelum grossum Uhler (1887*c*, p. 70).

Not taken in Illinois; known from District of Columbia, Florida, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Virginia; occurs on yellow pine (*Pinus echinata*).

Eustictus venatorius Van Duzee

Eustictus venatorius Van Duzee (1912, p. 479).

Not taken in Illinois; known from New York, where it occurs on hickory trees.

Eustictus necopinus Knight

Eustictus necopinus Knight (1923*d*, p. 481).

Not taken in Illinois; known from British Columbia, District of Columbia, Massachusetts, New York, Ontario; occurs on aspen.

Deraeocoris Fieber

KEY TO GROUPS AND SUBGENERA

1. Claws not cleft or only slightly cleft, fig. 34 .... **Group C,** p. 72
   Claws deeply cleft near base, figs. 33, 35 2
2. Scutellum punctate........... **Group A,** Subgenus **Camptobrochis,** p. 66
   Scutellum impunctate............... 3
3. Dorsum practically glabrous, at most only sparsely and finely pubescent (*not rubbed specimens*), rarely with a few hairs at anterior angle of pronotum; hind tibiae with a row of spines or heavily chitinized hairs on anterior face......... **Group B,** p. 69
   Dorsum heavily pubescent or hairy, at least with long hairs at anterior angles of pronotum; hind tibiae without distinct spines on anterior face, usually closely set with prominent long hairs............. **Group D,** Subgenus **Euarmosus,** p. 73

Group A

KEY TO SPECIES

1. Dorsum bright red; clavus, a pair of large spots on corium and pronotum black................. **histrio,** p. 69
   Dorsum not red and black as above... 2
2. Cuneus red or stained with reddish; membrane hyaline or with only a fuscous spot at apex, or a point either side of middle.................... 3
   Cuneus infuscated or marked with black, rarely reddish; if reddish, membrane distinctly black; membrane usually heavily marked with fuscous; if not, cuneus without a trace of reddish.................. 4
3. Length of second antennal segment not equal to length of pronotum; two fuscous spots on apical half of membrane, darkest specimens developing

a brownish cloud distad of spots.... ....**ornatus**, p. 67
Length of second antennal segment at least equal to length of pronotum; membrane infuscated at apex...... ....**poecilus**, p. 67

4. Membrane nearly clear, but having two small fuscous points, one at either side on apical half...**nebulosus**, p. 67
Membrane with apical half heavily infuscated............**nubilus**, p. 69

Deraeocoris nebulosus (Uhler)

Camptobrochis nebulosus Uhler (1872, p. 417).

ADULT.—Length 3.50–3.90, width 1.75–2.00; ovate, shining; olivaceo-testaceous, darkened with black, or fuscous to black with pale markings; membrane clear, a pair of small fuscous points on apical half, one on either side of middle. Male genitalia as in fig. 106.

HABITS.—Predacious; occurs most frequently on bur oak (*Quercus macrocarpa*) and maple (*Acer* sp.), but also on other trees.

KNOWN DISTRIBUTION.—Common in the eastern states and westward to Texas and Colorado.

Illinois Records. — One hundred fifty males and 175 females, taken May 11 to Nov. 1, are from Algonquin, Allerton, Alton, Antioch, Cary, Centralia, Champaign, Chicago, Cobden, Danville, De Soto, Dolson, Dubois, Eichorn, Elizabeth, Ernst, Fairmount, Frankfort, Galena, Galesburg, Giant City, Grafton, Grand Tower, Harrisburg, Havana, Kansas, Lawrenceville, Meredosia, Metropolis, Milford, Monticello, Muncie, Normal, Oquawka, Palos Park, Paris, Quincy, Rockford, Rockton, Springfield, Starved Rock State Park, Urbana, Warsaw, White Heath, White Pines Forest State Park, Willow Springs, Zion.

Deraeocoris ornatus Knight

Deraeocoris (*Camptobrochis*) *ornatus* Knight (1921, p. 99).

This species is very similar to *poecilus* (McAtee), but the second antennal segment is shorter in proportion to the length of the pronotum and the punctures on the disk are finer; the two rounded fuscous spots on the apical half of the membrane are suggestive of *nebulosus* (Uhler), but the darkest specimens of *ornatus* may develop a brownish cloud distad of the spots.

MALE.—Length 4.50, width 2.08. Head width 1.01, vertex 0.40. Antennae, first segment, length 0.34; second, 1.11, scarcely equal to length of pronotum, thickness 0.08, black, brown annulus indicated at middle; third, 0.40; fourth, 0.40. Pronotum, length 1.14, width at base 1.92; calli black, a reddish brown stripe extends around posterior margin and more or less toward anterior angles of disk; grayish testaceous, paler near margins of disk and at median line, not so distinctly brownish as in *poecilus*. Scutellum reddish brown to piceous, punctures black, apex and lateral margins ivory white, median line usually indicated. Hemelytra grayish, translucent; punctures, frenal margin, areas bordering commissure, spot at middle, and stripe along apical margin of corium, piceous; tip of embolium translucent, reddish. Cuneus red, translucent, paler at inner angle and outer margin; several very fine, black punctures evident. Membrane pale, brachium infuscated, more or less invading membrane on both sides; a pair of rounded fuscous spots present on apical half, one either side of middle, darkest specimens developing a brownish cloud distad of spots. Genitalia as in fig. 106.

FEMALE.—Length 4.80, width 2.34; very similar to male. Second antennal segment, length 1.08; slightly shorter than length of pronotum, which is 1.20, black, middle one-third testaceous or brownish; all other segments black.

KNOWN DISTRIBUTION. — Illinois, Iowa, Missouri, Nebraska, South Dakota.

Illinois Records.—DIXON SPRINGS: May 9, 1935, C. O. Mohr, 4 ♀. EICHORN: May 11, 1933, C. O. Mohr, 1 ♀. GOLCONDA: May 10, 1935, C. O. Mohr, 1 ♀. PIKE: June 28, 1934, DeLong & Ross, 2 ♀. VIENNA: June 14, 1934, DeLong & Ross, 1 ♀. One female labeled "Ill." in the C. V. Riley collection, USNM.

Deraeocoris poecilus (McAtee)

Camptobrochis poecilus McAtee (1919, p. 246).

Deraeocoris cuneatus Knight (1921, p. 96).

ADULTS.—Length 4.00–5.00, width 2.00–2.50; slightly larger than, but structurally very close to, *nebulosus* (Uhler); olivaceo-testaceous to brownish and black, cuneus red, membrane clear, a rather distinct, some-

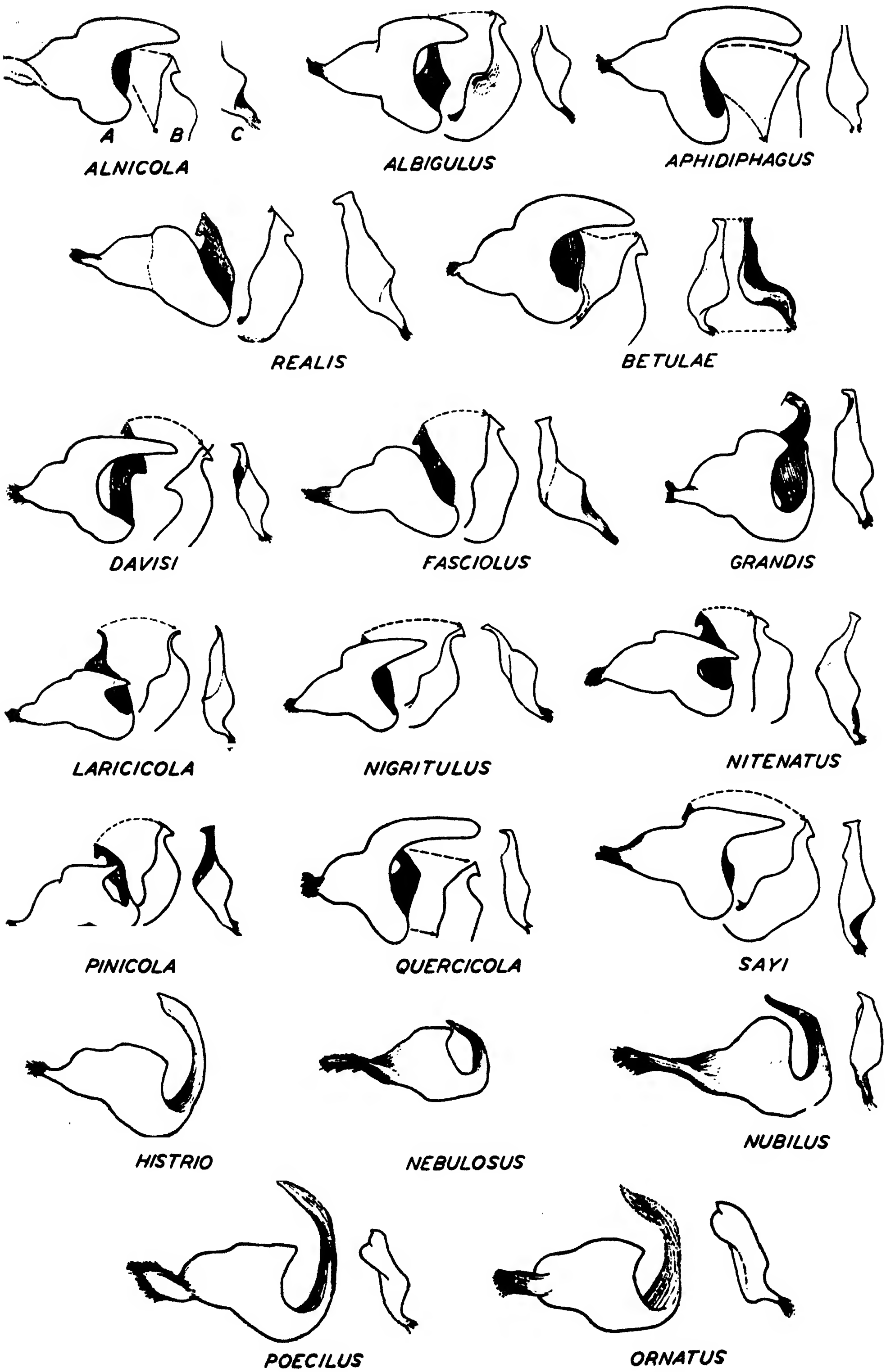


Fig. 106.—Male genital claspers of *Deraeocoris*. *A*, *B*, left clasper; *C*, right clasper.

what oval-shaped, fuscous spot at apex. Male genitalia as in fig. 106.

HABITS.—Predacious; occurs most frequently on alder (*Alnus rugosa*) and red birch (*Betula nigra*).

KNOWN DISTRIBUTION.—Illinois, Minnesota, New York, Pennsylvania, West Virginia.

Illinois Records.—Thirty males and 25 females, taken May 1 to July 26, are from Antioch, Carmi, Charleston, Eichorn, Elizabethtown, Galena, Grafton, Grand Tower, Harrisburg, Havana, Herod, Lawrenceville, Metropolis, Pike, Quincy, Rock Island, Starved Rock State Park, West Union.

Deraeocoris histrio (Reuter)

Callicapsus histrio Reuter (1876, p. 75).

ADULTS.—Length 4.50–5.00, width 2.00–2.30; dorsum bright red; clavus, a pair of large spots on corium and pronotum black. Male genitalia as in fig. 106.

HABITS.—Found breeding on smartweed (*Polygonum muhlenbergii*) in Minnesota and Colorado, where it appeared to be predacious in part on certain Fulgoridae.

Illinois Records.—Sixty-two males and 51 females, taken May 4 to Nov. 10, are from Algonquin, Argo, Bath, Canton, Champaign, Chicago, Galesburg, Grand Tower, Havana, Homer Park, Kampsville, Metropolis, Normal, Palos Park, Putnam, Quincy, Savanna, Savoy, Starved Rock State Park, Urbana.

Deraeocoris nubilus Knight

Deraeocoris (*Camptobrochis*) *nubilus* Knight (1921, p. 106).

ADULTS.—Length 4.20–4.80, width 2.00–2.30; male more elongate than female, apical half of membrane usually heavily infuscated; disk of pronotum fuscous to black behind calli, median line pale; femora biannulate with apical half pale. Male genitalia as in fig. 106.

HABITS.—Occurs on pine (*Pinus strobus*); probably predacious.

KNOWN DISTRIBUTION.—Illinois, Minnesota, Nebraska, New England states, New York, North Carolina, Virginia.

Illinois Records.—STARVED ROCK STATE PARK: July 14, 1932, on *Pinus strobus*, Dozier & Park, 1 ♂; Sept. 17, 1935, DeLong & Ross, 1 ♀. WHITE PINES FOREST STATE PARK: July 4, 1932, on *Pinus strobus*, Dozier & Mohr, 66 ♂, 57 ♀; July 12, 1934, DeLong & Ross, 2 ♀.

Group B

KEY TO SPECIES

1. Tibiae with fuscous or pale bands.... 2
   Tibiae uniformly pale or yellowish... 7
2. Membrane with a distinctly rounded fuscous spot on apical half, frequently connected at base by a fuscous streak extending down from between areoles, thus leaving a large pale spot on either side of middle and on area bordering apex of cuneus..................... 3
   Membrane usually somewhat infuscated, but not as above.......... 4
3. Calli solid black, a broad piceous ray behind each; in pale specimens, calli may be somewhat brownish, but, in such cases, median line and margins of disk distinctly pale, leaving a dark brown ray behind each callus; hemelytra with clavus and corium piceous, embolium pale ....**borealis,** p. 71
   Calli more or less invaded with brownish, or pale, distinct rays not apparent behind calli; hemelytra and pronotum more uniformly colored, either dull yellowish brown or dark brown........................ .....**fasciolus** var. **fasciolus** p. 70
4. Rostrum extending slightly beyond posterior margins of hind coxae; membrane with apical half scarcely infuscated; femora pale but with two distinct black bands near apex; hind tibiae with two fuscous annuli on basal half.........**grandis,** p. 71
   Rostrum scarcely attaining posterior margins of hind coxae; membrane, femora and hind tibiae not having above combination of characters.. 5
5. Femora uniformly dark on apical half, likewise basal part in darkest specimens; venter distinctly reddish, sometimes dark chestnut red, shining................**betulae,** p. 70
   Femora with apical half distinctly banded or entirely pale.... 6
6. Second antennal segment provided with prominent, pale, erect hairs, their length equal to three times thickness of segment; pronotum

with discoidal margins pale, calli and posterior part of disk black, forming a ray behind each callus, thus leaving median line pale........................... **alnicola**, p. 70

Second antennal segment without prominent, exserted hairs or, if such hairs present, their length never more than twice thickness of segment; pronotal disk without distinct rays, sometimes black, but lateral margins not distinctly paler................... **aphidiphagus**, p. 71

7. Hind femora with two brown or fuscous bands near apex; apical half of membrane with a distinctly rounded fuscous spot, usually connected at base by a fuscous streak that extends up between large areoles........................ 8

Hind femora with but one fuscous band; apical half of membrane pale or clouded with fuscous, but fuscous area not forming a rounded spot on apical half............... 9

8. Calli solid black, a broad piceous ray behind each; in pale specimens, calli may be somewhat brownish, but, in such case, median line and margins of disk distinctly pale, leaving a dark brown ray behind each callus; hemelytra with clavus and corium piceous, embolium pale....................... **borealis**, p. 71

Calli more or less invaded with brownish or pale areas, distinct rays not apparent behind calli; hemelytra and pronotum more uniformly colored, fulvo-testaceous to dark brownish............................. **fasciolus** var. **castus**, p. 70

9. Dorsum uniformly very dark brown; calli and scutellum black............................... **davisi**, p. 72

Dorsum pale to testaceous and brownish, frequently becoming fuscous or black but always with some pale areas; calli margined with black or entirely black...................10

10. Calli black only around margins, dorsum rich brownish to deep brown, shining........... **nitenatus**, p. 72

Calli entirely black, or, if not, dorsum pallid and with three darkened spots on each hemelytron, one at apex, one at middle and one at base.11

11. Dorsum fuscous to black, usually with a pale median line running over disk and scutellum; hemelytra darkened to such an extent that three blotch-like, fuscous spots are not apparent ..**quercicola** var. **quercicola**, p. 71

Dorsum pallid brown with three dark spots, one at base, one at middle and one at apex of each hemelytron; calli usually entirely black, but, in pale specimens, calli only margined with black........................ .....**quercicola** var. **pallens**, p. 71

Deraeocoris betulae Knight

Deraeocoris betulae Knight (1921, p. 129).

No Illinois specimens; known from the New England and Middle Atlantic states; occurs on birch (*Betula lutea*). Male genitalia as in fig. 106.

Deraeocoris alnicola Knight

Deraeocoris alnicola Knight (1921, p. 132).

No Illinois specimens; known from Connecticut, Ontario, New York; occurs on alder (*Alnus incana*). Male genitalia as in fig. 106.

Deraeocoris fasciolus Knight

Deraeocoris fasciolus Knight (1921, p. 123).

Adults.—Length 6.50, width 2.80–3.10; usually slightly smaller than *borealis* (Van Duzee), disk of pronotum more uniformly colored, calli more or less invaded with brownish or pale and without distinct rays behind; left genital clasper very similar to that of *borealis*, but right clasper distinctive, fig. 106.

In the variety *fasciolus castus* Knight (1921, p. 125) the tibiae are uniformly yellowish rather than partly dark, as in the typical form; *castus* has not been taken in Illinois.

Habits.—Occurs on hawthorns (*Crataegus* sp.) and apple trees, where it feeds on the rosy aphid, *Macrosiphum rosae* (Linnaeus). In New York the author found the white, wax-coated nymphs of *D. fasciolus* frequenting the aphid-curled leaves, feeding on aphids and their honeydew excretions.

Illinois Records.—Northern Illinois: July, 1 ♂, 1 ♀. Antioch: Aug. 1, 1930, Frison, Knight & Ross, 1 ♀. Galena: June 30, 1932, Dozier & Mohr, 1 ♀. Monticello: June 11, 1934, Frison & De-

Long, 1 ♂, 1 ♀. WAUKEGAN: July 6, 1932, on *Tilia* sp., T. H. Frison, 1 ♀. WILLOW SPRINGS: July 8, 1906, W. J. Gerhard, 1 ♀, FM.

Deraeocoris borealis (Van Duzee)

Camptobrochys borealis Van Duzee (1920, p. 354).

Not taken in Illinois; known from Michigan, Minnesota, Ohio, Wisconsin; occurs on alders. Male genitalia as in fig. 106.

Deraeocoris grandis (Uhler)

Camptobrochis grandis Uhler (1887*a*, p. 230).

ADULTS.—Length 6.40–7.00, width 2.90–3.10. Distinguished by its long rostrum, which reaches the second abdominal sternite. Dorsum rather uniformly dark brown; median line of pronotal disk with a rather broad, pale stripe, but this area only slightly paler than that behind calli. Legs pale; apical half of hind femora and basal half of tibiae with two black annulations. Membrane uniformly pale smoky on the apical half. Male genitalia as in fig. 106.

HABITS.—Occurs on hickory (*Carya* sp.).

KNOWN DISTRIBUTION. — Illinois, Iowa, Maryland, New York, Ontario.

Illinois Records.—NORTHERN ILLINOIS: 1 ♀. CHAMPAIGN: June 15, 1888, at electric light, C. A. Hart. FRANKFORT: June 8, 1933, on *Carya* sp., Mohr & Townsend, 2 ♂, 3 ♀.

Deraeocoris aphidiphagus Knight

Deraeocoris aphidiphagus Knight (1921, p. 134)

ADULTS.—Fig. 107. Length 5.80–6.10, width 2.90–6.10. Fusco-grayish to black, paler and translucent parts not stained with brownish; apical half of membrane infuscated; tibiae with three black annulations; left genital clasper with a long horn at dorsal extremity, internal arm slender, fig. 106.

HABITS.—I have found this species breeding only on elm (*Ulmus* sp.), in curled leaves infested with *Eriosoma americanum* (Riley). Both nymphs and adults feed on the aphids and their honeydew excretions. The nymphs are coated with a white, wax-like material similar to that which covers the aphids, and in the early stages, at least, they are rather inconspicuous, as they live among the aphids and their excretory products. This species of mirid must be regarded as a beneficial species, as it reduces the numbers of elm aphids.

KNOWN DISTRIBUTION.—Several eastern states; taken as far west as Arkansas, Colorado, Minnesota, North Dakota, South Dakota.

Illinois Records. — Twenty-one males and 13 females, taken June 5 to July 18, are from Alto Pass, Antioch, Augerville, Champaign, Elgin, Frankfort, Galesburg, Grand Detour, Hardin, Lacon, Normandy, Urbana, Willow Springs.

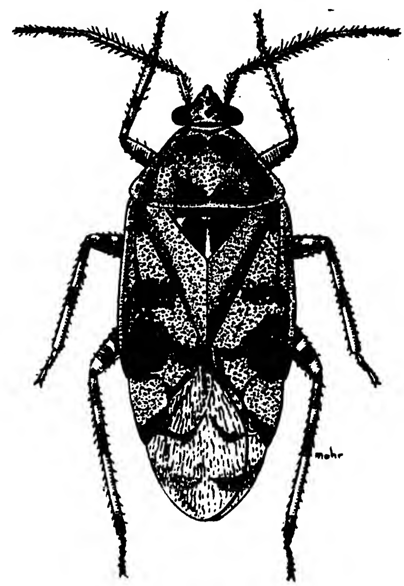


Fig. 107.—*Deraeocoris aphidiphagus*, ♂.

Deraeocoris quercicola Knight

Deraeocoris quercicola Knight (1921, p. 138).

ADULTS.—Length 5.50–5.80, width 2.40–2.80. General color fuscous to black. Calli black; apical half of membrane smoky, rarely as pale as in *nitenatus* Knight. Left genital clasper with a long dorsal horn that is very distinctive when contrasted with the form of the internal arm, fig. 106.

Specimens of this species in which the calli are more or less pale, the hemelytra are pallid or yellowish, and the corium has a black spot in the middle, have been designated variety *pallens* Knight (1921, p. 140). This variety and the typical one occur together in Illinois.

HABITS.—Occurs on white oak (*Quercus*

alba), bur oak (*Quercus macrocarpa*), basswood (*Tilia* sp.) and hawthorn (*Crataegus* sp.).

KNOWN DISTRIBUTION.—A common species in the northeastern states; known also from Colorado, Iowa, Minnesota, New Mexico, and southeastward into Georgia and North Carolina.

Illinois Records.—Thirty-two males and 36 females, taken June 2 to July 16, are from Antioch, Apple River Canyon State Park, Champaign, Chicago, Elizabethtown, Frankfort, Galena, Galesburg, Grand Detour, Keithsburg, Manito, Monticello, Mount Carroll, Urbana, Waukegan, White Pines Forest State Park, Willow Springs, Zion. Blatchley (1926*b*, p. 900) also records this species from Glen Ellyn.

Deraeocoris davisi Knight

Deraeocoris davisi Knight (1921, p. 140).

ADULTS.—Length 5.30, width 2.50. General color uniformly brownish black; legs and antennae chiefly pale, hind femora with an incomplete dark annulus on apical half; membrane with apical half very faintly but uniformly stained with brownish, veins and areoles darkened with brownish; closely related to *quercicola* Knight, but the internal arm of left clasper more highly developed, fig. 106.

KNOWN DISTRIBUTION. — An uncommon species, known only from Alabama, Illinois, New York, North Carolina, Texas.

Illinois Records.—POLO: May 31, 1933, Ross & Townsend, 1 ♂. VIENNA: June 14, 1934, savanna grasses, DeLong & Ross, 1 ♀.

Deraeocoris nitenatus Knight

Camptobrochis nitens Reuter (1909, p. 56). *Preoccupied.*

Deraeocoris nitenatus Knight (1921, p. 141).

ADULTS.—Length 5.70–6.00, width 2.00–2.90. General aspect very similar to *quercicola* Knight, but more highly polished, calli black around margins only. Dorsum rich brownish to dark brownish and piceous, frequently brownish on scutellum, but rarely black each side of median line. Brachium and apex of areoles dark fuscous, apical half of membrane practically clear; male genital claspers distinctive for species, fig. 106.

HABITS.—Breeds on elm (*Ulmus* sp.), basswood (*Tilia americana*), and other trees, where it is predacious on the woolly aphid, *Eriosoma lanigerum* (Hausmann), and, probably, other aphids.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Iowa, Maryland, Minnesota, New England, North Carolina, Quebec, Virginia.

Illinois Records.—ANTIOCH: July 5-7, 1932, on *Tilia* sp., T. H. Frison *et al.*, 1 ♂. GALESBURG: July 24, 1892, 1 ♂, 1 ♀.

Group C

KEY TO SPECIES

1. Dorsum practically glabrous, at most only sparsely and finely pubescent (*not rubbed specimens*), rarely with a few hairs at anterior angles of pronotum 2
   Dorsum heavily pubescent, at least with long hairs at anterior angles of pronotum 3
2. Second antennal segment of female with prominent exserted hairs, length of hairs one and one-half times the thickness of segment where they occur. Second antennal segment of male as thick at middle as on the apical half, and length of exserted hairs equal to one and one-half times the thickness of segment............................... **laricicola,** p. 73
   Second antennal segment of female with erect hairs but length of hairs barely equal to twice the thickness of segment where they occur. Second antennal segment of the male slender on basal half, distinctly thicker on apical half than at middle; length of hairs not greater than maximum thickness of second segment............................ **pinicola,** p. 73
3. Pronotum, hemelytra and legs uniformly dark, sepia brown or black, semitranslucent areas stained with brownish; hind tibiae usually with distinct annulated pale bands on apical half......... **nigritulus,** p. 73
   Pronotum usually fusco-grayish or black; hemelytra fuscous to black, becoming paler in certain areas but not stained with brownish; legs very dark brown, hind tibiae sometimes with indistinct pale bands on apical half; front coxae, xyphus, lower margins of propleura, gula, and sides of tylus, pale.......... **albigulus,** p. 73

Deraeocoris pinicola Knight

Deraeocoris pinicola Knight (1921, p. 162).

ADULTS.—Length 5.70–6.00, width 2.60–2.90; calli margined or lined with black, antero-lateral angles invaded by light-colored areas; median line of front and areas just anterior to calli pale to ivory white: general color pale to grayish, darkened with black, not at all tinged with brownish. Male genitalia as in fig. 106.

HABITS.—Occurs on white pine (*Pinus strobus*); predacious on *Chermes pinicorticis* (Fitch). This species may also attack aphids, such as *Cinara strobi* (Fitch) and *Eulachnus rileyi* (Williams), which commonly occur on white pines growing in Illinois.

KNOWN DISTRIBUTION. — Iowa, Minnesota and states to the east where white pine grows.

Illinois Records.—WHITE PINES FOREST STATE PARK: July 4, 1932, on *Pinus strobus*, Dozier & Mohr, 1 ♀; June 4, 1933, on *Pinus strobus*, Ross & Townsend, 1 ♂.

Deraeocoris laricicola Knight

Deraeocoris laricicola Knight (1921, p. 164).

ADULTS.—Length 6.00–6.50, width 2.70–2.80; very suggestive of *pinicola* Knight, but slightly larger and more elongate. Antennae with prominent, exserted hairs; male genital claspers distinctive, fig. 106.

HABITS.—Occurs on larch (*Larix laricina*).

KNOWN DISTRIBUTION. — Illinois, Indiana, Minnesota, New York.

Illinois Records.—ANTIOCH: July 5-7, 1932, T. H. Frison *et al.*, 6 ♀. VOLO: June 11, 1936, Ross & Burks, 2 ♂, 2 ♀.

Deraeocoris nigritulus Knight

Deraeocoris nigritulus Knight (1921, p. 170).

Not taken in Illinois. Breeds on Virginia pine (*Pinus virginiana*); known from District of Columbia, Maryland, Ohio, Virginia. Male genitalia as in fig. 106.

Deraeocoris albigulus Knight

Deraeocoris albigulus Knight (1921, p. 171).

Not yet collected in Illinois. Occurs on pine; known from Indiana, Iowa, Michigan, Minnesota, New York; will surely be found in Illinois eventually. Male genitalia as in fig. 106.

Group D

Deraeocoris sayi (Reuter)

Euarmosus sayi Reuter (1876, p. 76).

ADULTS.—Length 7.40–7.90, width 3.40–3.80; distinctly hairy. Color chiefly black, with considerable variation in the color of the head, pronotum and scutellum. In the darkest form, var. *unicolor* Knight (1921, p. 177), these parts are mostly or entirely black; in the lightest form, var. *sayi*, most of them are reddish. Various intermediate conditions occur between these extremes, those taken in Illinois representing var. *marginata* Knight (1921, p. 176), *frontalis* Knight (1921, p. 177) and *costalis* Knight (1921, p. 177). Male genitalia, fig. 106.

HABITS.—Occurs on oaks (*Quercus* sp.).

KNOWN DISTRIBUTION.—Described from Texas and since found in Florida, Georgia, Illinois, Iowa, Massachusetts, Michigan, Minnesota, Mississippi, New York, North Carolina.

Illinois Records.—NORTHERN ILLINOIS: 2 ♂. SOUTHERN ILLINOIS: 1 ♀. ALGONQUIN: May 27, 1899, 1 ♂; June 8-12, 1900, 2 ♂; June 13, 1905, Nason, 1 ♂. CHICAGO: June 9, 1 ♂. GALESBURG: Stromberg, 1 ♂, 1 ♀; June 12-14, 1 ♂, 1 ♀; July 17, 1892, 1 ♀; June 14-19, 1893, Stromberg, 1 ♂, 1 ♀. GLEN ELLYN: June 18-19, W. J. Gerhard, 1 ♂, FM, 2 ♂, 1 ♀.

Eurychilopterella Reuter

KEY TO SPECIES

Dorsum of body fuscous to black on a pale background............**luridula,** p. 73

Dorsum of body uniformly fuscous brown ....**brunneata,** p. 74

Eurychilopterella luridula Reuter

Eurychilopterella luridula Reuter (1909, p. 60).

MALE.—Fig. 108. Length 4.50, width 1.80; fuscous to black on a pale background; pronotum coarsely punctured; dorsum clothed with stiff, erect pubescence.

FEMALE.—Length 4.40, width 1.03; more robust than male, but very similar in coloration.

HABITS.—Occurs on apple (*Pyrus malus*) and elm (*Ulmus* sp.); evidently predacious in habits.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Iowa, Minnesota, New York, South Carolina, Virginia.

Illinois Records. — ILLINOIS: July 9, 1892, 1 ♀. NORTHERN ILLINOIS: 2 ♂. CHICAGO: Aug. 10, 1909, A. B. Wolcott, 1 ♀, FM; Sept. 12, 1919, on elm, W. J. Gerhard, 1 ♀, FM. URBANA: July 7, 1915, tree trunk, 1 ♀; Sept. 28, 1915, tree trunk, 1 ♂.

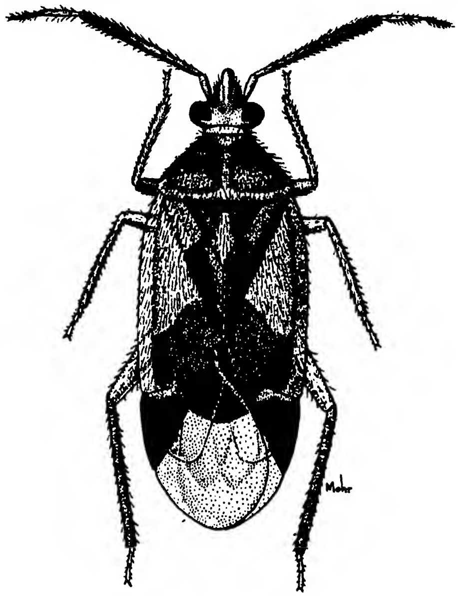


Fig. 108.—*Eurychilopterella luridula*, ♂.

Eurychilopterella brunneata Knight

Eurychilopterella brunneata Knight (1927*d*, p. 141).

This species is distinguished from *luridula* Reuter by its uniformly fuscous-brown coloration, longer head and larger size.

MALE.—Length 4.70, width 2.10. Head width 0.86, vertex 0.38, head length 0.71, extending 0.44 beyond front of eyes; horizontal, flattened beneath; gula slightly sulcate; lower margins of eyes extending slightly below gula. Rostrum, length 3.20, reaching to base of genital segment. Antennae, first segment, length 0.29, more slender on basal half; second, 1.26, cylindrical, equal to thickness of first segment; third, 0.44; fourth, 0.36; last two segments slender. Pronotum, length 1.18, width at base 1.77; disk more distinctly flattened than in *luridula*, coarsely and closely punctate; calli confluent, smooth, smaller than in *luridula*. General color dark, fuscous brown; pronotum slightly darker; head, collar and legs more yellowish brown; membrane and veins uniformly brownish. Clothed with thickly set, erect, rather long, yellowish brown pubescence.

Illinois Record.—CLAY CITY: Aug. 17, 1911, C. A. Hart, 1 ♂.

Hesperophylum Reuter

Hesperophylum heidemanni Reuter

Hesperophylum heidemanni Reuter (1912*b*, p. 17).

This is a rare species, yet widely distributed as indicated by the few records. Originally described from a New Hampshire specimen, it was later taken at Washington, D. C. (Heidemann). H. G. Barber (1914, p. 170) recorded it from Arizona. The most recent record is a female specimen, taken June 26, 1931, in Ames, Iowa (H. H. Knight); it was collected while sweeping under trees. This species has not been found in Illinois, but doubtless it will be eventually. The male is unknown.

In previous books this genus has frequently been considered in a separate family, the Termatophylidae.

ORTHOTYLINAE

KEY TO TRIBES

1. Eyes pedunculate, head very broad, fig. 19 .... **LABOPINI,** p. 81
   Eyes not pedunculate, head not unusually broad, figs. 109, 113 2
2. Pronotum with pleural area separated from dorsal part by a distinct suture, fig. 22; pronotal disk raised posteriorly and projecting above scutellum; clothed with dense, bristly pubescence .... **SEMIINI,** p. 75
   Pronotum without a distinct lateral suture; pronotal disk not projecting above scutellum 3
3. Antlike species with abdomen constricted at base, figs. 137–141 4
   Body not antlike in form, figs. 112, 113 5
4. Second and third segments of antennae equal in thickness, fig. 137 .... **SYSTELLONOTINI,** p. 116
   Second segment of antennae considerably thicker than third, fig. 141 .... **PILOPHORINI,** p. 118

5. Small, light-colored species clothed with intermixed erect pubescence and scalelike hairs, and with vertex not carinate, fig. 110. .**HALTICINI,** p. 75
   Not having that combination of characters: if scalelike hairs present, vertex carinate. 6
6. Small, compact, black species with saltatorial femora, figs. 111, 112, 115 . . . .**HALTICINI,** p. 75
   Not compact, black species with saltatorial femora. 7
7. Second and third segments of antennae equal in thickness, fig. 135. . . . .**CERATOCAPSINI,** p. 107
   Second segment of antennae considerably thicker than third, fig. 129. . . . .**ORTHOTYLINI,** p. 81

SEMIINI

Semium Reuter

Semium hirtum Reuter

Semium hirtum Reuter (1876, p. 80).

ADULTS.—Fig. 109. Length 2.80, width 1.00; legs and antennae red; head, apex of pronotum, and sides of thorax, rosy red; basal half of pronotum, clavus, bar across apex of corium, and tip of cuneus, velvety brown, remaining parts of corium and cuneus white; body densely clothed with erect, bristly pubescence.

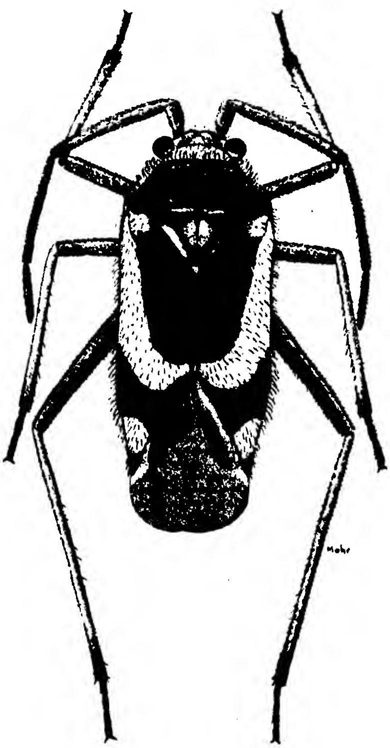


Fig. 109.—*Semium hirtum*, ♀.

FOOD PLANTS.—Spurges (*Euphorbia adenoptera* and *E. humistrata*); lives on the red undersides of the leaves; two Illinois specimens were taken on sugar beet (*Beta vulgaris*), but may not have been feeding there.

KNOWN DISTRIBUTION.—Described from Texas, and now known also from California, District of Columbia, Illinois, Indiana, Iowa, Kansas, New Jersey, New York, Ohio, Pennsylvania.

Illinois Records.—Twenty-three males, 65 females and 2 nymphs, taken July 3 to Oct. 13, are from Borton, Centralia, Chicago, Dongola, Dubois, Fountain Bluff, Galesburg, Green Valley, Jewett, Lawrenceville, Monticello, Savanna, Urbana.

HALTICINI

KEY TO GENERA

1. Head without a well-defined, sharp, posterior margin, fig. 110; head and dorsum thickly clothed with closely appressed, scalelike hairs interspersed with more nearly erect, long hairs; small species, varying in color from pale to dull black. . . . .**Parthenicus,** p. 76
   Head with well-defined, sharp, posterior margin, fig. 113; color black. 2
2. Antennae very long and slender, second segment four or more times as long as first segment, fig. 111; brachypterous forms common and have oval body, strongly convex, fig. 112. . . . .**Halticus,** p. 77
   Antennae shorter, second segment little more than three times as long as first segment, fig. 113. 3
3. Length of hairs on third antennal segment three times as great as thickness of segment; antennae and head with long, coarse, black hairs. . . . .**Orthocephalus,** p. 81
   Antennae with much shorter pubescence, fig. 115; head and body in most species nearly glabrous. . . . .**Strongylocoris,** p. 78

Parthenicus Reuter

KEY TO SPECIES

1. Body color fuscous to black; first antennal segment black, second segment pale.......... **nigrellus**, p. 77
   Body straw colored to yellowish; antennae pale...................... 2
2. Body and legs uniformly pale yellowish or pinkish, without flecks or dots .... **taxodii**, p. 76
   Body more or less pale, hind femora pale fuscous, usually sprinkled with reddish dots; scutellum fuscous; cuneus tinted with red................................ **juniperi**, p. 76

Parthenicus juniperi (Heidemann)

Psallus juniperi Heidemann (1905, p. 49).

MALE.—Fig. 110. Length 3.00, width 1.00. General color pale yellowish. Cuneus, apical one-third of corium and base of head tinged with reddish, color sometimes separating into specks; femora pale fuscous, sprinkled with reddish; scutellum and base of clavus darkened with fuscous. Body clothed with fine, erect, golden pubescence, intermixed with more closely appressed, scalelike, golden hairs, the hairs tending to silvery on scutellum and on transverse area extending across corium at tip of clavus; pubescence becoming black across apex of corium and forming a spot on inner edge of cuneus at middle and at base; membrane uniformly infuscated and iridescent.

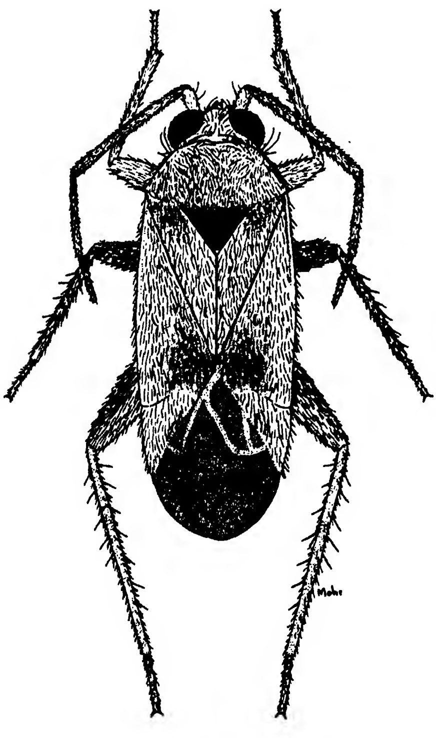


Fig. 110.—*Parthenicus juniperi*, ♂.

FEMALE.—Very similar to male in form and color.

FOOD PLANT.—Red cedar (*Juniperus virginiana*).

KNOWN DISTRIBUTION.—Ranges widely east of the 100th meridian, occurring nearly everywhere red cedar grows in natural stands.

Illinois Records. — Twenty-one males and 108 females, taken June 10 to July 25, are from Alton, Antioch, Eichorn, Ernst, Galena, Golconda, Grayville, Hillsboro, Kampsville, Karnak, Keithsburg, Oquawka, Starved Rock State Park, Urbana, White Pines Forest State Park.

Parthenicus taxodii new species

This may be distinguished from allied species by its small size, its uniformly yellowish salmon color and its pale fuscous membrane.

MALE.—Length 2.00, width 0.90. Head width 0.54, vertex 0.17. Rostrum, length 0.73, extending very slightly behind posterior coxae. Antennae yellowish to dusky; length of first segment, 0.13; second, 0.73; third, 0.43; fourth, 0.30. Pronotum, length 0.34, width at base 0.73. Dorsum clothed with deciduous, silvery to golden, sericeous pubescence intermixed with more nearly erect, simple, pale pubescence. General coloration rather uniformly yellowish to salmon; strongly colored specimens may have scutellum dusky and clavus tinted salmon pink; membrane uniformly pale fuscous; veins yellowish.

FEMALE.—Length 2.20, width 0.91. Head width 0.47; vertex 0.26. Pronotum, length 0.32, width at base 0.75. Antennae, length of first segment, 0.13; second, 0.70; third, 0.40; fourth, 0.29. Form more robust than that of male, but very similar in pubescence and coloration.

FOOD PLANT.—Bald cypress (*Taxodium distichum*).

Holotype, male.—Karnak, Ill.: July 26, 1930, on *Taxodium distichum*, Knight & Ross.

Allotype, female.—Same data as for holotype.

Paratypes. — ILLINOIS. — Same data as for holotype, 39 ♂, 42 ♀. CAIRO: July 27, 1930, on *Taxodium distichum*, Knight & Ross, 2 ♂, 6 ♀. JONESBORO: Aug. 2, 1932, H. L. Dozier, 17 ♂, 34 ♀. KARNAK: June 23, 1932, Ross, Dozier & Park, 1 ♂, 1 ♀; June 14, 1934, on *Taxodium distichum*, DeLong & Ross, 3 ♂, 10 ♀. SHAWNEETOWN: June 14, 1934, DeLong & Ross, 1 nymph. URBANA: Aug. 28, 1917, 1 ♂, 3 ♀, 1 nymph.

Parthenicus nigrellus Knight

Parthenicus nigrellus Knight (1939*a*, p. 23).

This species is distinguished from the other members of the genus by its black color and pale second antennal segment.

MALE.—Length 3.30, width 1.60. Head width 0.73, vertex 0.34. Rostrum, length 1.40, just attaining hind margins of posterior coxae. Antennae, first segment, length 0.39; black; second, 1.18, pale, tinged with reddish, clothed with pale and dusky pubescence; third, 0.91, pale; fourth, 0.60, fuscous. Pronotum, length 0.60, width at base 1.25. Form ovate, robust; general color fuscous black with a tinge of red in hypodermis which is more pronounced on ventral surface, tips of femora, and base and apex of cuneus; membrane uniformly fuscous; veins reddish. Legs black, tibiae pale except basal one-third; tarsi pale, apices fuscous. Clothed with pale to yellowish pubescence intermixed with silvery, scalelike hairs. Genital claspers distinctive, right clasper spatulate at apex and curved so as to form a V-shaped loop which turns back over middle of genital segment.

FEMALE.—Length 3.50, width 1.70. More robust than male, but very similar in form, color and pubescence.

KNOWN DISTRIBUTION. — Georgia, Illinois, Iowa, Texas.

Illinois Records.—MONTICELLO: June 11, 1934, Frison & DeLong, 1 ♂, 2 ♀. SEYMOUR: July 7, 1937, Mohr & Burks, 1 ♂ 2 ♀.

Halticus Hahn

KEY TO SPECIES

1. Body devoid of scalelike pubescence; length of second antennal segment only slightly exceeding width of pronotum at posterior margin.............................**apterus,** p. 77
   Body above with spots of deciduous, scalelike pubescence, figs. 110, 111; length of second antennal segment considerably greater than width of pronotum at posterior margin...... 2
2. Second antennal segment yellow, apex with a narrow fuscous area; length 3.50............**intermedius,** p. 77
   Second antennal segment black, or, at least, with base and apex black; length 2.00–2.20....**bracteatus,** p. 77

Halticus apterus (Linnaeus)

Cicada aptera Linnaeus (1758, p. 438).

Not taken in Illinois; known from Maine, Nova Scotia, Ontario.

Halticus intermedius Uhler

Halticus intermedius Uhler (1904, p. 360).

Not taken in Illinois; known from Colorado, Mississippi, New York, North Dakota, Ohio, Ontario, Pennsylvania; breeds on virgin's bower (*Clematis virginiana*).

Halticus bracteatus (Say)

Garden Flea Hopper

Cylapus bracteatus Say (1832, p. 26).
Rhinacloa citri Ashmead (1887, p. 155).

MALE.—Fig. 111. Length 1.90–2.00, width 0.70. General color black, slightly shining; antennae fuscous, middle of second segment and base of third pale; usually first antennal segment pale also. Apices of femora, tibiae (except bases of posterior pair), and all tarsi, pale. Body clothed with very fine, pale pubescence, with deciduous, tomentose patches that give silvery and greenish reflections.

FEMALE.—Fig. 112. Length (brachypterous) 1.50, width 1.00; length (macropterous) 2.20; first antennal segment dark; usually brachypterous, but frequently winged like male.

FOOD PLANTS.—White clover (*Trifolium repens*), beans (*Phaseolus* sp., etc.), plantain (*Plantago lanceolata*); also recorded on many other plants. This is a pest of considerable importance on leguminous crops.

KNOWN DISTRIBUTION.—Common through states of Middle West and East.

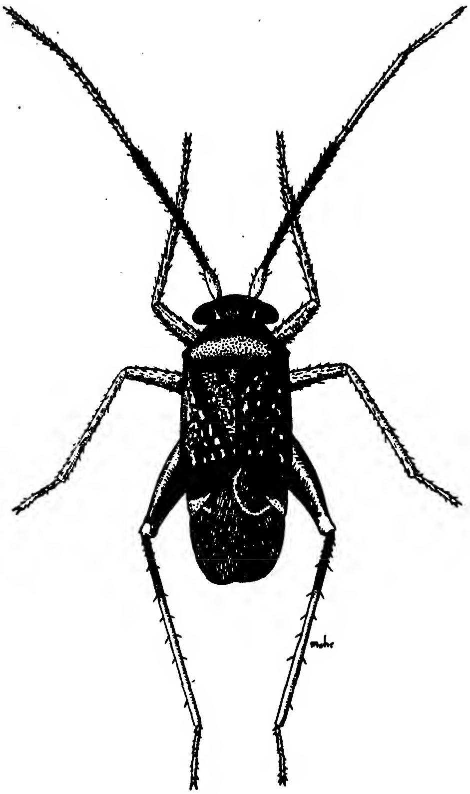


Fig. 111.—*Halticus bracteatus*, ♂.

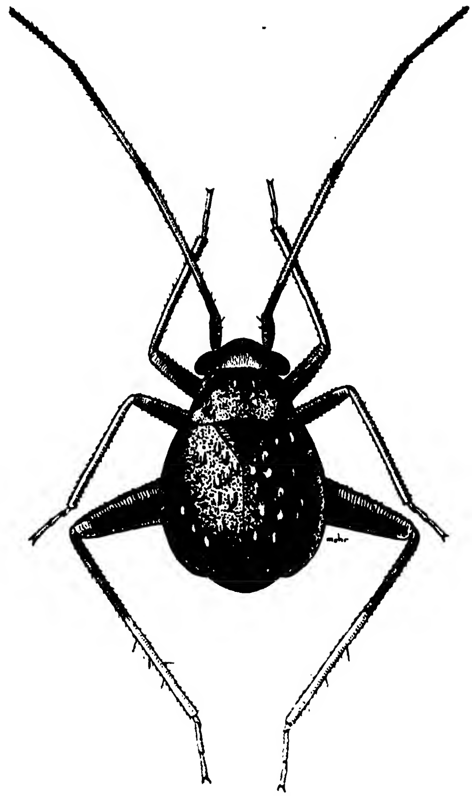


Fig. 112.—*Halticus bracteatus*, ♀.

Illinois Records.—Forty-two males and 86 females, taken May 29 to Oct. 3, are from Aldridge, Alton, Alto Pass, Anna, Bluffs, Carmi, Dolson, Dubois, Fountain Bluff, Freeport, Galena, Glen Ellyn, Golconda, Grand Tower, Grandview, Grayville, Henry, Karnak, Muncie, Normal, Paxton, Shawneetown, Starved Rock State Park, Tremont, Villa Ridge, Willow Springs, Wolf Lake, Urbana.

Strongylocoris Blanchard

KEY TO SPECIES

1. Dorsum glabrous or nearly so, fig. 114. 2
   Dorsum and body thickly clothed with erect pubescence, fig. 115.......... 5
2. Legs uniformly yellow to orange yellow ....**pallipes**, p. 79
   Legs with femora more or less black... 3
3. Hind tibiae yellow, sometimes dusky on basal half; second antennal segment yellow with narrow fuscous band at base and apex....**breviatus**, p. 79
   Hind tibiae black or fuscous, at least with more area black than pale; second antennal segment sometimes yellowish at middle, but broad fuscous area always present at base.... 4
4. Hind tibiae uniformly black; emboliar margins of hemelytra strongly arcuate..............**atritibialis**, p. 80
   Hind tibiae fuscous, becoming paler on distal half; emboliar margins only moderately arcuate...**stygicus**, p. 79
5. Length of second antennal segment greater than width of head........ ....**hirtus**, p. 80
   Length of second antennal segment less than width of head.............. 6
6. Basal segments of tarsi pale, apical segment black; tibiae brownish, hind pair very dark brown; broad area on second antennal segment pale; costal margin of hemelytra strongly arcuate; length 4.30........**mohri**, p. 81
   Tarsi entirely black; tibiae uniformly pale; antennae uniformly black; costal margin of hemelytra only slightly arcuate; length 3.50.............. ....**ambrosiae**, p. 81

Strongylocoris stygicus (Say)

Capsus stygicus Say (1832, p. 24).

MALE.—Fig. 113. Length 4.20, width 2.00. Head width 0.99, vertex 0.54. Rostrum, length 1.04, reaching to middle of intermediate coxae. Antennae black; length of first segment, 0.30; second, 1.12; third, 0.86; fourth, 0.47. Pronotum, length 0.91, width at base 1.50. Form ovate, black, shining, finely but densely punctate, somewhat rugulose, nearly glabrous, sparsely set with fine, short pubescence; apices of femora, two anterior pairs of tibiae, all except apical segment of tarsi, and bases of trochanters, pale yellowish; hind tibiae fuscous to black, becoming paler on distal half. Male genital claspers distinctive, fig. 114.

FEMALE.—Length 4.40, width 2.10. More ovate and robust than male, but very similar in color, puncturation and scanty pubescence.

FOOD PLANT.—Goldenrod (*Solidago* sp.).

KNOWN DISTRIBUTION.—Commonly distributed in the eastern United States

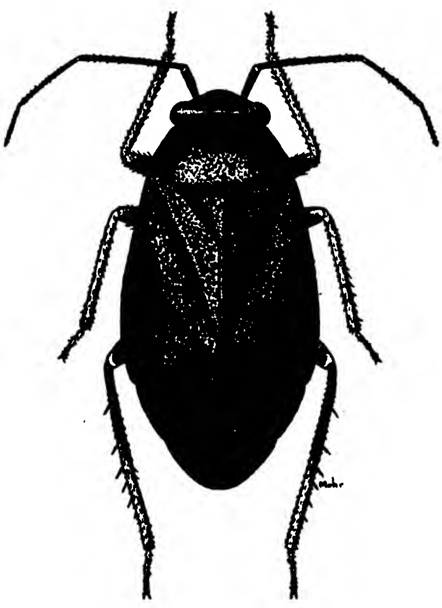


Fig. 113.—*Strongylocoris stygicus*, ♂.

and Canada and extending westward to Alberta, Colorado, Montana.

Illinois Records.—One hundred forty-five males, 36 females and 12 nymphs, taken May 6 to Sept. 21, are from Anna, Bloomington, Bluff Springs, Carbondale, Champaign, Charleston, Chicago, Cypress, Danville, Dolson, Edgebrook, Elizabethtown, Galena, Galesburg, Golconda, Goreville, Grand Detour, Grandview, Hamilton, Herod, Joliet, Jonesboro, Keithsburg, Makanda, Monticello, Mount Carmel, Muncie, Odin, Oquawka, Palos Park, Pulaski, Sheldon, Springfield, Urbana, Vienna, Warsaw, West Union, Willow Springs.

Strongylocoris pallipes Knight

Strongylocoris pallipes Knight (1926*h*, p. 254).

Not taken in Illinois; known from Maryland and Virginia. Male genitalia as in fig. 114.

Strongylocoris breviatus Knight

Strongylocoris breviatus Knight (1938, p. 1.)

This species is allied to *stygicus* (Say), but is distinguished by the yellowish first and second antennal segments, the latter having a distinct black band at the base; male genital claspers are distinctive for this species, fig. 114.

MALE.—Length 4.30, width 2.00. Head width 1.06, vertex 0.56. Antennae, first segment, length 0.35, yellowish brown, black at base; second, 1.30, brownish on basal half and black at base; third, 0.95, black; fourth, 0.47, black. Pronotum, length 0.91, width at base 1.51. Hemelytra with costal margin moderately arcuate. Dorsum finely and closely rugulose punctate, sparsely clothed with short, pale pubescence, this pubescence more apparent on lateral margins of hemelytra, paracuneus with three or four long hairs. General coloration deep black, shining; femora black, apices yellowish; tibiae uniformly yellowish, except hind pair, which have apices and variable area at base fuscous; tarsi yellowish, apical segment black.

FEMALE.—Length 4.10, width 2.20; hemelytra more sharply arcuate than in male. Head width 1.20, vertex 0.64. Antennae, first segment, length 0.36, yellow, base black; second, 1.17, yellow, apical one-fourth and narrow ring at base black; third, 0.86, black, yellowish at base; fourth, 0.44, black.

FOOD PLANT.—Goldenrod (*Solidago altissima*).

KNOWN DISTRIBUTION.—Nova Scotia and Maine to District of Columbia, and westward to Alberta, Minnesota, Montana.

Illinois Records.—Nineteen males and 22 females, taken May 21 to Aug. 25, are

from Anna, Antioch, Beach, Browns, Bureau, Champaign, Dolson, Golconda, Grand Detour, Herod, Makanda, Marshall, Mount

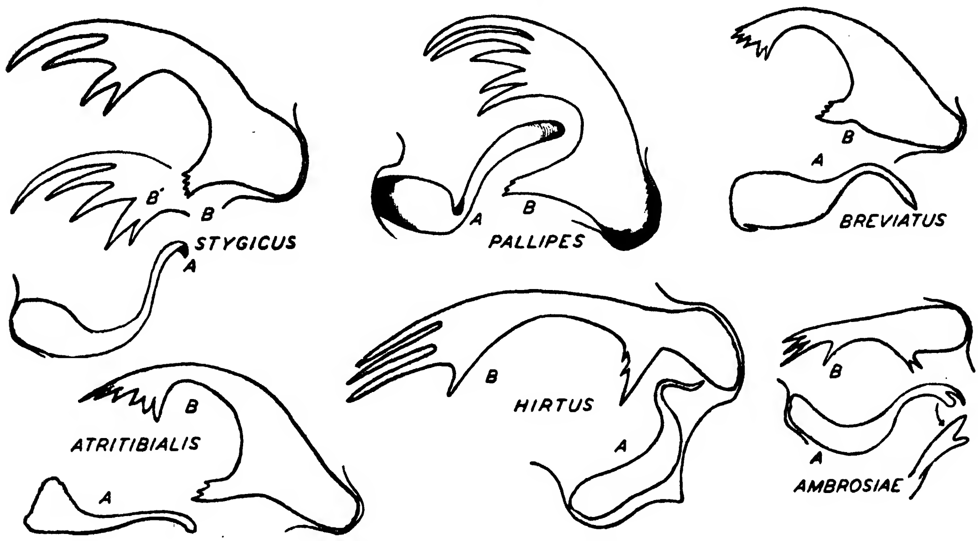


Fig. 114.—Male genital claspers of *Strongylocoris. A*, left clasper; *B*, right clasper.

Carmel, Oakwood, Oregon, Pulaski, Shawneetown, Urbana, West Union.

Strongylocoris atritibialis Knight

Strongylocoris atritibialis Knight (1938, p. 2).

This species is distinguished from *stygicus* (Say) by its more arcuate hemelytra, black tibiae and the structure of the male genital claspers, fig. 114.

MALE.—Length 4.60, width 2.40. Head width 1.21, vertex 0.65. Antennae black; length of first segment, 0.34; second, 1.26; third, 1.00; fourth, 0.43. Pronotum, length 1.12, width at base 1.77. Hemelytra with costal margin strongly arcuate. Dorsal surface nearly glabrous, rugulose, punctate, sparsely clothed with fine, short pubescence, which is more evident on cuneus and embolium. General coloration deep black; membrane very dark brown; legs black; tibiae and tarsi sometimes very dark brown, but hind tibiae always black. Genital claspers distinctive for species, fig. 114.

FEMALE.—Length 4.50, width 2.50; emboliar margins more strongly arcuate than in male. Form more robust than in male, but very similar in coloration.

KNOWN DISTRIBUTION.—Widely distributed in eastern United States and ranging westward into Alberta, Colorado, Wyoming.

Illinois Records.—Thirty-five males and 44 females, taken May 12 to July 15, are from Algonquin, Antioch, Browns, Charleston, Dolson, Dongola, Fountain Bluff, Galena, Galesburg, Grand Detour, Grayslake, Havana, Herod, Joliet, Makanda, Muncie, Pulaski, St. Anne, Shawneetown, Sheldon, Volo.

Strongylocoris hirtus Knight

Strongylocoris hirtus Knight (1938, p. 4).

This is distinguished from allied species with erect pubescence by the longer second antennal segment, which exceeds the width of the head across the eyes; the tibiae and first antennal segment are pale and the male genital claspers are distinctive, fig. 114.

MALE.—Length 4.60, width 2.20. Head width 1.12, vertex 0.56. Antennae, first segment, length 0.38, pale, base fuscous; second, 1.43, black, basal one-fifth pale; third, 0.86, black; fourth, 0.47, black. Pronotum, length 0.98, width at base 0.16. Hemelytra with costal margin moderately arcuate on distal half. Clothed with thickly set, erect, golden-brown to black pubescence. General coloration black, shining slightly; legs mostly black, with tibiae, all but apical segment of tarsi, and apices of femora, pale; tibial spines fuscous.

FEMALE.—Length 4.30, width 2.40. More robust than male, but very similar in color and pubescence.

FOOD PLANT.—Cup plant (*Silphium perfoliatum*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Kansas.

Illinois Records.—CHARLESTON: June 14, 1931, H. H. Ross, 1 ♂. HARDIN: June 5, 1932, H. L. Dozier, 1 ♂. WEST UNION: June 14, 1930, on *Silphium* sp., T. H. Frison, 4 ♂, 1 ♀; June 26, 1932, Ross & Dozier, 1 ♂, 1 ♀.

Strongylocoris mohri new species

This species is allied to *hirtus* Knight, but is distinguished by its longer pubescence, more arcuate hemelytra, and shorter second antennal segment, which does not equal the width of the head across the eyes.

FEMALE.—Fig. 115. Length 4.30, width 2.50. Rostrum, length 1.00, reaching to middle of intermediate coxae, black, with second segment pale. Antennae, first segment, length 0.30, black, slightly pale on apex; second, 0.99, cylindrical, tapering to become more slender on basal than on apical half, pale, apex black, base brownish, pubescence pale; third, 0.65, black, pale on base; fourth, 0.43, black. Pronotum, length 0.95, width at base 1.73. Hemelytra strongly arcuate, costal edge sharp, slightly reflexed, cuneus approximately triangular.

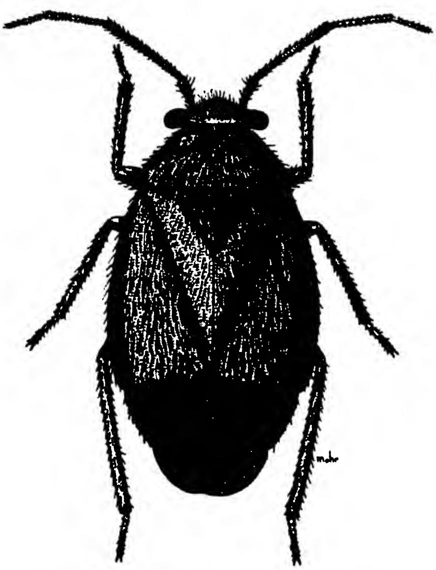


Fig. 115.—*Strongylocoris mohri*, ♀.

General coloration black, moderately shining, clothed with long, rather fine, erect, pale to brownish pubescence. Legs mostly black, with tips of femora slightly paler; tibiae pale to brownish, darker on basal half, hind pair nearly black; tarsi pale, apical segment black.

Holotype, female.—Hamilton, Ill.: June 9, 1932, Ross & Mohr.

Paratype.—CENTRAL ILLINOIS: 1 ♀.

Named for Dr. Dr. Carl O. Mohr, who made many of the illustrations for this work.

Strongylocoris ambrosiae Knight

Strongylocoris ambrosiae Knight (1938, p. 5).

Not yet collected in Illinois; known from Iowa, Kansas, South Dakota, Texas. Male genital claspers as in fig. 114.

Orthocephalus Fieber

No Illinois species; *Orthocephalus mutabilis* (Fallen) occurs in Maine, New York, Pennsylvania.

LABOPINI

Labops Burmeister

No Illinois species; *Labops hirtus* Knight is known from Colorado, Maine, Massachusetts, Montana, New York, Ontario.

ORTHOTYLINI

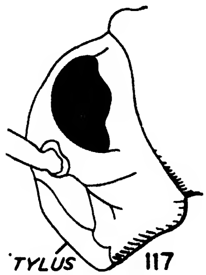
KEY TO GENERA

1. Posterior margin of vertex with a high, transverse ridge extending from eye to eye and bearing stout, black bristles, fig. 116. . . . . **Hadronema,** p. 84
   Posterior margin of vertex not having a ridge extending from eye to eye which bears stout, black bristles. . . 2
2. A well-defined, oblique suture on gena extending from antennal fossa to beneath eye, fig. 117, this suture frequently outlined by a dark stripe; red-orange and black species. . . . . **Lopidea,** p. 84
   Genal suture absent, or extending directly from antennal fossa to eye, fig. 118, or present, but vague and not outlined by a dark stripe. 3
3. Base of tylus markedly produced and located considerably ventrad of the

level of ventral margins of eyes, fig. 118 . . . . **Ilnacora,** p. 82

Base of tylus less angularly produced, not located ventrad of level of ventral margins of eyes, fig. 119; on a line with or considerably dorsad of level of ventral margins of eyes . . 4


116



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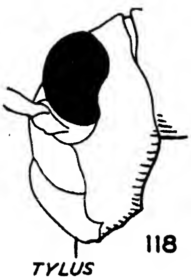

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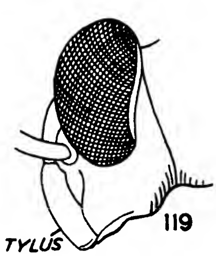


119

Fig. 116.—Head of *Hadronema militare.*

Fig. 117.—Head of *Lopidea confluenta.*

Fig. 118.—Head of *Ilnacora stalii.*

Fig. 119.—Head of *Mecomma gilvipes.*

4. Second antennal segment thickened at apex, fig. 133 . . . . **Heterocordylus,** p. 107

Second antennal segment linear, fig. 125 5

5. First antennal segment with a longitudinal black line on either side, these lines connected on ventral side near apex . . . . . . **Reuteria,** p. 92

First antennal segment not marked with longitudinal black lines 6

6. Eyes rounded behind and set at or near middle of head, well removed from anterior margin of pronotum, fig. 123 . . . . **Diaphnidia,** p. 91

Eyes relatively straight behind and set close to anterior margin of pronotum, fig. 129 7

7. Body clothed with scalelike hairs intermixed with more nearly erect bristles 8

Body clothed with simple pubescence only; sometimes with a few silky hairs 9

8. Pronotum and corium thickly clothed with black and white, scalelike pubescence, with a few bristles; venter very dark, almost black; third antennal segment equal to three times the length of fourth segment; large fuscous species, length 5.50–6.00 . . . . **Noctuocoris,** p. 105

Pronotum and corium bearing numerous erect bristles intermixed with scattered scalelike pubescence, fig. 152; venter light; third antennal segment not equal to three times the length of fourth segment; small species, length less than 5.00 . . . . **Melanotrichus,** p. 95

9. Vertex with a carina at posterior margin 10

Vertex without a carina at posterior margin 11

10. Head broad; width of vertex three times as great as dorsal width of an eye, fig. 130 . . . . . . **Labopidea,** p. 105

Head not so broad; width of vertex not more than two times as great as dorsal width of an eye, fig. 129 . . . . **Orthotylus,** p. 97

11. Head vertical, strongly compressed apically, fig. 119; as viewed from the side, tip of tylus projecting below posterior end for a distance equal to one-half height of eye; pronotum sinuate at base and slightly so at sides; male and female dissimilar in form; female brachypterous, abdomen very broad, macropterous forms rare . . . . **Mecomma,** p. 95

Head inclined, more prognathous; as viewed from side, tip of tylus not projecting below posterior end of gula for a space equal to half the height of eye; both sexes macropterous . . . . **Cyrtorhinus,** p. 95

Ilnacora Reuter

KEY TO SPECIES

1. Length of first antennal segment exceeding width of vertex 2

Length of first antennal segment less than width of vertex 3

2. Hemelytra deep green, membrane black................**malina,** p. 83
   Hemelytra pale or light green, membrane pale..............**stalii,** p. 84
3. Frons with transverse black mark; first antennal segment mostly pale, with base and apex black.................................**divisa,** p. 83
   Frons without transverse black mark; first antennal segment mostly black, broad area at base and narrow one at apex pale.............**illini,** p. 83

Ilnacora malina (Uhler)

Sthenarops malina Uhler (1877, p. 419).

ADULTS.—Length 5.40, width 1.60. Head, body and antennae chiefly black; hemelytra and base of pronotum bright green; anterior part of pronotum, two stripes on scutellum, and legs, greenish yellow; a round, black spot behind each callosity; membrane black; male right genital clasper, fig. 120.

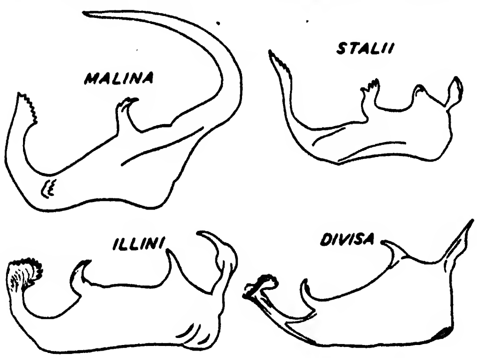


Fig. 120.—Right male genital claspers of *Ilnacora*.

FOOD PLANT.—Goldenrod (*Solidago* sp.) in moist, shaded situations; Illinois specimens were collected also on ragweed (*Ambrosia* sp.), oak (*Quercus* sp.) and locust (*Robinia pseudoacacia*), the last two undoubtedly "sitting" records only.

KNOWN DISTRIBUTION.—Widely distributed in the eastern United States and Canada.

Illinois Records.—One hundred twelve males and 106 females, taken May 27 to July 19, are from Algonquin, Bureau, Charleston, Danville, Dug Hill, Elizabeth, Elizabethtown, Freeport, Galena, Galesburg, Grand Detour, Hardin, Herod, Joliet, Lilly, Morris, Monticello, Mount Carmel, New Milford, Oakwood, Oquawka, Oregon, Palos Park, Pegrim, River Forest, Sheldon, Springfield, Urbana, Vienna, Warsaw, White Heath, Willow Springs.

Ilnacora illini new species

This species is allied to *stalii* Reuter, but is distinguished by its shorter antennal segments and the expanded apex of the right genital clasper, fig. 120.

MALE.—Length 4.80, width 1.50. Head width 0.91, vertex 0.51. Rostrum, length 1.30, reaching to middle of intermediate coxae. Antennae, first segment, length 0.48, less than width of vertex, black with broad area at base and narrow area at apex pale; second, 1.80, yellowish brown to fuscous, darker near base; third, 1.60, yellowish to fuscous; fourth, 0.73, fuscous. Pronotum, length 0.78, width at base 1.20. Dorsum clothed with erect, pale hairs sparsely intermixed with patches of black, deciduous, scalelike hairs; pronotal spots and median basal spot on scutellum similar to those in *stalii.* General coloration pale, tinged with greenish on dorsum; hemelytra semitranslucent; membrane pale; a small transverse, fuscous cloud near apex of cuneus; veins greenish; legs principally pale to greenish, with tibial spines brownish; apical segment and claws of each tarsus black. Male genital claspers distinctive, right clasper with apex spatulate, fig. 120.

Holotype, male, — Elizabethtown, Ill., May 27-31, 1932, H. L. Dozier.

Paratypes.—ILLINOIS.—VIENNA: May 18, 1932, H. L. Dozier, 1 ♂, KC.

OKLAHOMA. — STILLWATER: May 15, 1939, K. C. Emerson, 1 ♂, 1 ♀, KC.

Ilnacora divisa Reuter

Ilnacora divisa Reuter (1876, p. 86).

MALE.—Length 4.70, width 1.60. Head black, width 1.00, vertex 0.56; vertex and frons pale, a black median line and arcuate line above base of each antenna joining at base of frons on meson. Rostrum, length 1.17, reaching to middle of intermediate coxae. Antennae, first segment, length 0.37, pale, black at base and fuscous at apex; second, 1.38, dusky, fuscous at base and near apex; third, 1.21, fuscous; fourth, 0.65. Pronotum, length 0.75, width at base 1.30. Body mostly black; pronotum and hemelytra, greenish, scutellum paler green; membrane uniformly fuscous, with greenish veins; legs mostly pale, with tarsi and tibial

spines black. Dorsum clothed with erect, simple pubescence intermixed on hemelytra with patches of deciduous, black, scalelike hairs; spot behind each callosity, median line between callosities, and spot on base of scutellum formed by masses of black, scalelike pubescence. Male genital claspers distinctive for species, fig. 120.

FEMALE.—Length 4.70, width 1.80. Form slightly more robust than that of male, but color and pubescence very similar.

FOOD PLANT.—A single Illinois specimen was collected on milkweed (*Asclepias* sp.).

KNOWN DISTRIBUTION.—Colorado, Illinois, Iowa, Minnesota, North Dakota, Texas.

Illinois Records.—One male and 17 females, taken March 8 to Aug. 17, are from Bloomington, Champaign, Dubois, Galena, Galesburg, Teheran, Urbana.

Ilnacora stalii Reuter

Ilnacora stalii Reuter (1876, p. 86).

MALE.—Length 5.20, width 1.60. Head width 0.95, vertex 0.49. Rostrum, length 1.30, just attaining apices of middle coxae, pale, with apical segment black. Antennae, first segment, length 0.54, exceeding width of vertex, pale, apical half and ring at base black; second, 1.95, dusky, more fuscous on apex; third, 1.60, black; fourth, 0.65, black. Pronotum, length 0.82, width at base 1.34. General coloration pale or whitish; hemelytra and legs tinged with greenish; membrane pale; veins greenish. Dorsum clothed with erect, pale hairs sparsely intermixed with patches of black, deciduous scalelike hairs; a round, black spot behind each callosity and a median basal spot on scutellum formed by black, deciduous hairs. Male genital claspers distinctive, right clasper terminating in a slender, dorsally projecting point, fig. 120.

FEMALE.—Length 5.40, width 1.80. More robust than male, but very similar in pubescence and color.

FOOD PLANTS.—Breeds on cocklebur (*Xanthium* sp.), sunflower (*Helianthus* sp.), artichoke (*H. tuberosus*) and perhaps on other weeds. A single specimen was collected on wild grape (*Vitis* sp.).

KNOWN DISTRIBUTION.—Colorado, Montana, Texas, eastward to District of Columbia, New York, North Carolina.

Illinois Records.—Ninety-eight males and 146 females, taken May 23 to Sept. 22, are from Algonquin, Alton, Alto Pass, Antioch, Beardstown, Browns, Cairo, Camargo, Carbondale, Champaign, Charleston, Chicago, Cornland, Decatur, De Soto, East St. Louis, Effingham, Elizabeth, Elizabethtown, Fountain Bluff, Freeport, Galena, Galesburg, Hardin, Harrisburg, Ingleside, Kampsville, Kankakee, Karnak, Keithsburg, Lawrenceville, Meredosia, Metropolis, Monticello, Mounds, Mount Carmel, Oquawka, Palos Park, Rockford, Rockton, Rosiclare, St. Joseph, Seymour, Shawneetown, Starved Rock State Park, Teheran, Urbana, Ware, Warren, West Pullman, Willow Springs, York.

Hadronema Uhler

No Illinois species; *Hadronema militare* Uhler is known from Colorado, Kansas, Michigan, New York, South Dakota and westward.

Lopidea Uhler

KEY TO SPECIES

1. Apex of abdomen with a pair of claspers (males); all characters in couplets 2–14 are illustrated in fig. 121 2
   Apex of abdomen without claspers (females) 15
2. Left clasper with a plainly visible, baso-mesal, flat-hooked tooth .... **staphyleae,** p. 90
   Left clasper without such a tooth 3
3. Tip of right clasper short, large and somewhat rounded, with a short, serrate, dorsal tooth just before apex .... **media,** p. 89
   Tip of right clasper without such a dorsal tooth at apex 4
4. Base of right clasper produced into a long, dorsal, curved arm .... **robiniae,** p. 89
   Base of right clasper without a long, basal, dorsal projection 5
5. Right clasper ending in a curved tooth which is either long, *e.g.*, *instabilis* or blunt, *e.g.*, *lathyri* 6
   Right clasper ending in a serrate lobe, *e.g.*, *amorphae–salicis* 8
6. Right clasper with a preapical hook which may be reduced to a small swelling .... **instabilis,** p. 91

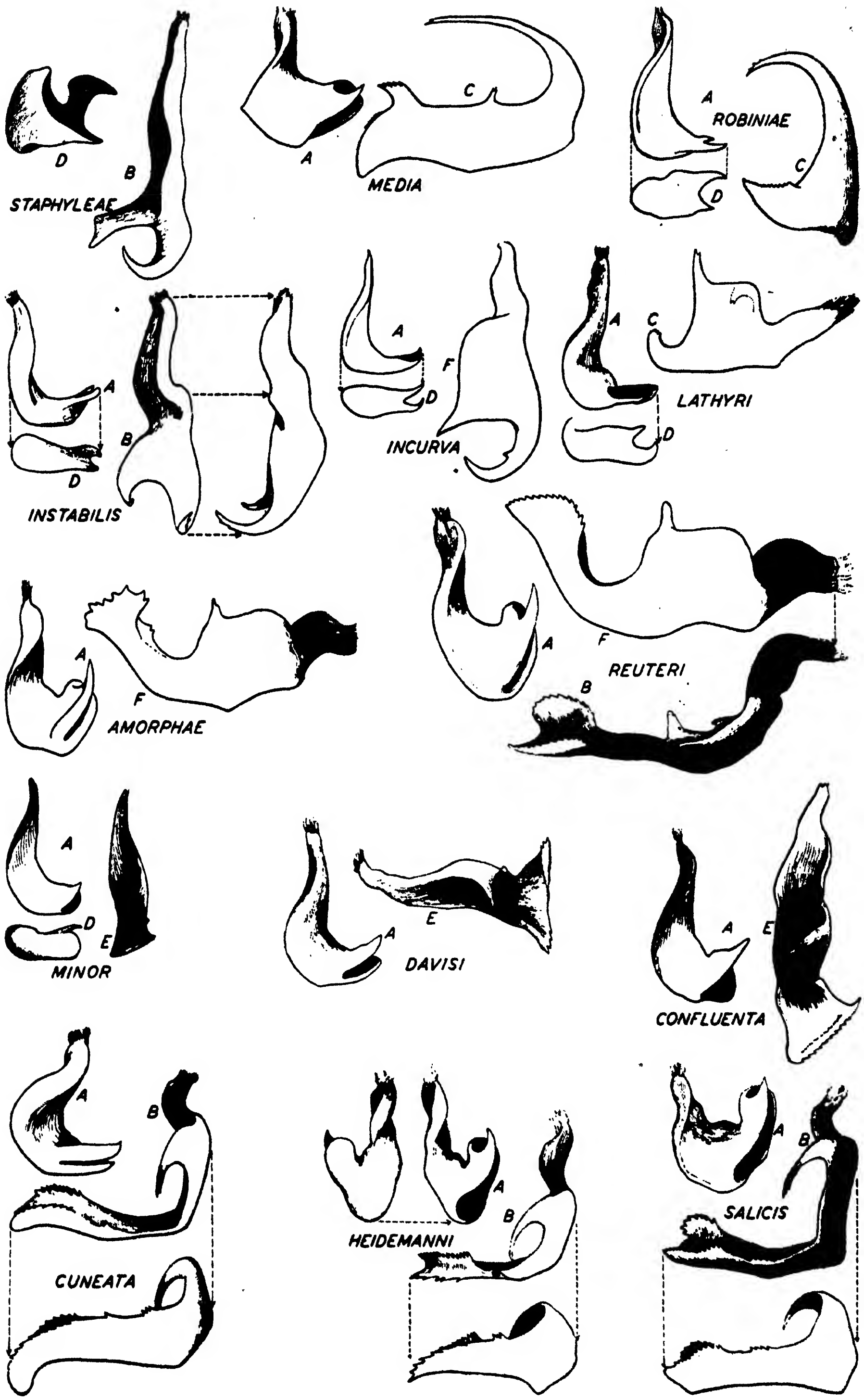


Fig. 121.—Male genital claspers of *Lopidea*. *A*, left clasper, dorsal aspect; *B*, right clasper, dorsal aspect; *C*, right clasper, caudal aspect; *D*, left clasper, caudal aspect; *E*, right clasper, mesal aspect; *F*, right clasper, lateral aspect.

Right clasper with a preapical enlargement which is somewhat rectangular and produced into an apical point, *e.g.*, *incurva*, *lathyri*. . 7

7. Apical hook of right clasper long and sharp, fig. 121 . . . . **incurva**, p. 88
Apical hook of right clasper shorter and with tip slightly serrate. . . . . **lathyri**, p. 91

8. Right clasper with base bulbous, center constricted and apex expanded into an upturned, serrate lobe, *e.g.*, *amorphae*, *reuteri*. 9
Right clasper otherwise, without an upturned, apical lobe, *e.g.*, *minor–salicis*. 10

9. Serrate margin of apical lobe more irregular and truncate. . . . . **amorphae**, p. 90
Serrate margin of apical lobe regular, curving back on to inner curve of lobe. . . . . **reuteri**, p. 91

10. Apex of right clasper obliquely truncate, flat and serrate, *e.g.*, *minor*. . 11
Apex of right clasper pointed or irregular, with a second row of serrations on dorsal or mesal side, *e.g.*, *cuneata–salicis*. 13

11. Left clasper with dorsal tooth small. . . . . **minor**, p. 88
Left clasper with dorsal tooth large, *e.g.*, *davisi*. 12

12. Right clasper with both dorsal and ventral corners expanded and sharp . . . . **davisi**, p. 87
Right clasper with ventral corner round and not expanded. . . . . **confluenta**, p. 87

13. Right clasper with apex rounded and curved ventrad. . . . . . **cuneata**, p. 89
Right clasper with apex horizontal and pointed, *e.g.*, *salicis*. 14

14. Apex of right clasper with a double row of dorsal serrations. . . . . **heidemanni**, p. 88
Apex of right clasper with second row of dorsal serrations separated mesad as a definite lobe. . . . . . **salicis**, p. 89

15. Length of first antennal segment equal to or greater than width of vertex between eyes. 16
Length of first antennal segment less than width of vertex between eyes. 22

16. Bases of first and second antennal segments equal in thickness, second segment tapering apically to become more slender than first segment. 17
Base of second antennal segment not so thick as base of first. 18

17. Length of second antennal segment approximately twice width of head across eyes; length 5.80. . . . . **instabilis**, p. 91
Length of second antennal segment distinctly greater than twice width of head across eyes; length 6.70. . . . . **reuteri**, p. 91

18. Corium bearing both simple and sericeous pubescence; pronotal disk with erect, stiff, black hairs; general color yellowish to orange; scutellum and inner half of corium and clavus blackish; length 6.40. . . . . **robiniae**, p. 89
Corium with only simple pubescence; or, if a few minute, sericeous hairs present, pronotal disk without erect hairs. 19

19. Length of second antennal segment more than twice width of head across eyes; length 7.00. . . . . **staphyleae**, p. 90
Length of second antennal segment less than twice width of head across eyes. 20

20. Scutellum with a few black, bristle-like hairs; juga red; dorsum also with a broad, reddish area; length 5.20–5.40. . . . . **media**, p. 89
Scutellum with minute, soft pubescence only; juga pale. 21

21. Second antennal segment clothed with very short, recumbent, golden pubescence. . . . . **cuneata**, p. 89
Second antennal segment clothed with prominent, semierect, black, bristle-like hairs. . . . . **salicis**, p. 89

22. Second antennal segment thickened, diameter near base equal to that of first segment although tapering apically to become more slender. . . . . **reuteri**, p. 91
Second antennal segment slender, its greatest thickness not approaching that of first segment. 23

23. Length of second antennal segment equal to twice width of head across eyes; length 6.50. . . . . **confluenta**, p. 87

Length of second antennal segment less than twice width of head across eyes ... 24

24. Corium with outer half bearing suberect, black hairs ... 25
Corium with outer half bearing pale hairs; or, if dark, pubescence minute and closely appressed ... 26

25. Corium bearing simple pubescence intermixed with more closely appressed, sericeous pubescence ... **heidemanni**, p. 88
Corium bearing only suberect, bristly pubescence ... **davisi**, p. 87

26. Length not over 5.20 ... 27
Length 5.60 or more ... 28

27. Corium infuscated across its full width; pubescence very short, appressed; length 5.00–5.20 ... **incurva**, p. 88
Corium reddish on its outer half; pubescence suberect, pale in color; length 4.20–4.30 ... **minor**, p. 88

28. Outer half of corium fuscous to black ... **cuneata**, p. 89
Outer half of corium orange to red ... 29

29. Pubescence on dorsum minute, closely appressed; embolium never pale, yellowish to red like outer half of corium ... **amorphae**, p. 90
Pubescence on dorsum suberect; embolium usually pale or white ... **lathyri**, p. 91

Lopidea confluenta (Say)

Capsus confluentus Say (1832, p. 23; 1859, p. 341).

MALE.—Length 6.30, width 2.10. Yellowish orange, tinged with reddish; broad area on either side of commissure, entire membrane, scutellum, and variable area on pronotal disk, fuscous; antennae, tylus, rostrum, base of head, and a stripe each side of front, black; legs mostly blackish, with trochanters and apices of coxae yellowish; genital claspers, fig. 121, distinctive for species.

FEMALE.—Fig. 122. Length 6.50, width 2.40; more robust than male, but very similar in coloration.

FOOD PLANTS.—Leafcup (*Polymnia uvedalia* and probably *P. canadensis*); in Illinois specimens were collected also on sweet William (*Phlox* sp.), daisy (*Chrysanthemum* sp.), red clover (*Trifolium pratense*), persimmon (*Diospyros virginiana*), willow (*Salix* sp.), snowberry (*Symphoricarpos orbiculatus*), locust (*Robinia pseudoacacia*)

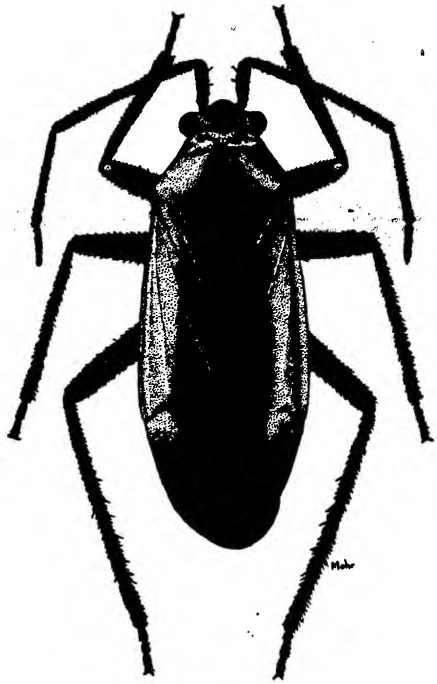


Fig. 122.—*Lopidea confluenta*, ♀.

and cypress (*Taxodium distichum*). Several of these plants undoubtedly are not hosts of this mirid.

KNOWN DISTRIBUTION.—Widely distributed in the eastern United States, but more abundant in the upper Mississippi valley.

Illinois Records.—Ninety-four males and 97 females, taken June 10 to Aug. 21, are from Anna, Beardstown, Bloomington, Dolson, Dubois, Elizabethtown, Ernst, Galesburg, Golconda, Grafton, Grand Tower, Grantsburg, Grayville, Havana, Herod, Kansas, Lawrenceville, Monticello, Muncie, Palos Park, Pike, Pulaski, Shawneetown, Starved Rock State Park, Urbana, Walnut Prairie, White Heath, Willow Springs.

Lopidea davisi Knight

Phlox Plant Bug

Lopidea davisi Knight (1917*d*, p. 458.)

MALE.—Length 5.50, width 2.00. Yellowish orange to reddish; antennae, legs, front of head, and rostrum, black; calli, base

of pronotum, scutellum, clavus, inner half of corium, and membrane, fuscous; genital claspers, fig. 121, distinctive for species.

FEMALE.—Length 5.60, width 2.10; more robust than male, but very similar in color and pubescence.

FOOD PLANTS.—When the original description appeared the food plant of this species was unknown, but as early as 1925 the insect had appeared as a serious pest of cultivated phlox in Arkansas, Missouri, Minnesota and West Virginia. This insect breeds on the wild species of phlox and may fly to the cultivated varieties within reach. The bug overwinters as an egg in the dead stems of phlox; it hatches in the spring and crawls upon the new growth to suck nourishment from the leaves. The feeding punctures cause brown spots to develop; the leaves curl, dry out and finally drop. Control of this pest may be obtained by destroying all dead plant tops before spring, when the eggs would hatch. Toward the end of the season, this species is often found on a wide range of herbs, but it does not breed on them.

Illinois Records.—One hundred thirty-seven males and 117 females, taken June 3 to Sept. 30, are from Ashland, Beach, Champaign, Charleston, Cobden, Dolson, Eichorn, Eldorado, Equality, Galena, Grandview, Herod, Jacksonville, Jerseyville, Norris City, Oak Lawn, Oakwood, Quincy, St. Anne, Schuyler County, Tolono, Urbana, Waterman, Watseka, Waukegan.

Lopidea minor Knight

Lopidea minor Knight (1918*b*, p. 213).

MALE.—Length 4.50, width 1.60. Fuscous; exterior half of corium, cuneus, sides of body and head, reddish; embolium paler; clothed with fine, suberect, pale pubescence, a few hairs brownish on darker areas. Genital claspers distinctive for species, fig. 121; showing a close relationship to *davisi* Knight, which species is, however, much larger.

FEMALE.—Length 4.20, width 1.60. More robust than male, but very similar in color and pubescence.

HOST PLANT.—Prairie clover (*Petalostemum purpureum*).

KNOWN DISTRIBUTION.—Alberta, Colorado, Illinois, Iowa, Mississippi, New York, North Dakota.

Illinois Record.—OAK LAWN: Sept. 6, 1935, T. H. Frison, 3 ♂, 1 ♀.

Lopidea incurva Knight

Lopidea incurva Knight (1918*b*, p. 214).

MALE.—Length 5.00, width 1.60. Second antennal segment slightly thickened at middle and tapering toward base and apex. Dorsum fuscous, with only exterior margins of corium, pronotum and cuneus reddish; membrane, antennae, eyes, rostrum and most of face fuscous. Legs mostly pale fuscous; coxae and basal half of femora pale to yellowish and pink; tarsi fuscous to black. Clothed with minute, closely appressed, fuscous pubescence. Genital claspers as in fig. 121.

FEMALE.—Length 5.00–5.20, width 1.80, slightly more robust than male, but very similar in color and pubescence.

HOST PLANT.—Honey locust (*Gleditsia triacanthos*).

KNOWN DISTRIBUTION. — Illinois, Indiana, Iowa, Missouri, Nebraska, Ohio.

Illinois Records.—Ten males and 35 females, taken July 3 to July 30, are from Alton, Champaign, Darwin, Dubois, Fountain Bluff, Galesburg, Grafton, Kansas, Monticello, Muncie, Paxton, Urbana.

Lopidea heidemanni Knight

Lopidea heidemanni Knight (1917*d*, p. 456).

MALE.—Length 6.70, width 2.14. Dark red, with more fuscous on pronotum and scutellum than in *media* (Say); larger and more elongate than *media*. Hemelytra of dry specimens always having a strong tendency to shrivel and wrinkle longitudinally. Dorsum clothed with simple, black hairs sparsely intermixed with more closely appressed, silvery, sericeous pubescence. Genital claspers distinctive, fig. 121, right clasper showing a close relationship with *cuneata* Van Duzee and *salicis* Knight.

FEMALE.—Length 6.20, width 2.08; slightly more robust than male, otherwise very similar. Costal margins of hemelytra frequently pale, as in *media*; in certain color phases, becoming dull orange red with fuscous. Head width 1.08, vertex 0.65. Antennae, length of first segment, 0.56; second, 1.90.

FOOD PLANTS. — Elm (*Ulmus* sp.); nymphs have been reared from common yarrow (*Achillea millefolium*). Occasional specimens were collected in Illinois on honey locust (*Gleditsia triacanthos*), willow (*Salix* sp.), snowberry (*Symphoricarpos*

orbiculatus) and bedstraw (*Galium aparine*).

KNOWN DISTRIBUTION.—Iowa and Minnesota to Connecticut and southward to North Carolina.

Illinois Records.—Eighty-two males and 121 females, taken May 6 to July 3, are from Aldridge, Carlinville, Charleston, Dolson, Dongola, Dubois, Elizabethtown, Fountain Bluff, Galesburg, Golconda, Goreville, Grayslake, Hardin, Harvard, Herod, Homer, Jacksonville, Jonesboro, Kampsville, Keithsburg, Makanda, Muncie, Murphysboro, Oakwood, Ozark, Palos Park, Pulaski, Rock Island, St. Joseph, Seymour, Shawneetown, Urbana, Vienna, West Union, Zeigler.

Lopidea cuneata Van Duzee

Lopidea cuneata Van Duzee (1910, p. 79).

MALE.—Length 5.80, width 2.00. Dorsum dark fuscous on a background of orange red; cuneus, embolium and base of radial vein more strongly reddish; pronotum dark fuscous, lateral margin of disk pale to reddish; antennae, head and legs chiefly black; mark along front margin of eyes, juga, genae, trochanters, and apices of coxae, pale; propleura, except area surrounding coxal cleft, pale reddish; venter reddish, darkened with fuscous; genital segment blackish; genital claspers, fig. 121, distinctive for species.

FEMALE.—Length 6.00, width 2.10; similar to male, but reddish coloration replaced chiefly by pale, frequently inner margin and apical angles of corium becoming pale.

FOOD PLANTS.—Poplars (*Populus deltoides, P. balsamifera*).

KNOWN DISTRIBUTION.—New York, Illinois, Minnesota.

Illinois Records.—GALESBURG: Sept. 2, 1892, Stromberg, 1 ♀. HARVARD: July 17, 1936, C. O. Mohr, 1 ♀. PIKE: June 28, 1934, DeLong & Ross, 1 ♀.

Lopidea robiniae (Uhler)

Capsus robiniae Uhler (1861, p. 24).

MALE.—Length 6.30, width 2.10. General color usually orange yellow, rarely reddish; scutellum, apical area of clavus, inner half of corium, broad central area on pronotal disk, inner halves of calli, and membrane, fuscous to black; antennae, tylus, rostrum, tibiae, and tarsi, black; femora fuscous, coxae partly yellowish. Clothed with closely appressed, silvery, sericeous pubescence intermixed with simple, erect hairs; setae on pronotal disk stiff and prominent; dark-colored areas provided with dark pubescence. Structures of male genital claspers distinctive for species; fig. 121.

FEMALE.—Length 6.40, width 2.10; slightly more robust than male, but very similar in pubescence and coloration.

FOOD PLANT.—Black locust (*Robinia pseudoacacia*). Also, two Illinois specimens were collected on peach (*Prunus persica*).

KNOWN DISTRIBUTION.—Commonly distributed in the eastern United States nearly everywhere the black locust grows.

Illinois Records.—Eighty-four males and 105 females, taken June 10 to Aug. 30, are from Algonquin, Alton, Anna, Antioch, Bishop, Bluff Springs, Bridgewater, Browns, Carbondale, Effingham, Elizabethtown, Galena, Galesburg, Havana, McClure, Monticello, Mound City, Normal, Rosiclare, Shawneetown, Springfield, Stonefort, Union Grove, Villa Ridge, West Union.

Lopidea salicis Knight

Lopidea salicis Knight (1917*d*, p. 457).

MALE.—Length 5.70, width 2.00. Mostly black; propleura and basal angles of pronotal disk orange; embolium and cuneus, except inner apical margin, yellowish to orange. Genital claspers, fig. 121, distinctive for species.

FEMALE.—Length 6.20, width 2.10. Very similar to male in size and coloration, sometimes slightly more robust.

FOOD PLANT.—Black willow (*Salix nigra*); a single specimen was taken in Illinois on elm (*Ulmus*), but it probably had not fed there.

KNOWN DISTRIBUTION.—Illinois, Iowa, Kansas, Minnesota, New York.

Illinois Records.—ILLINOIS: Stromberg, 3 ♀. ELIZABETHTOWN: May 27-31, 1932, H. L. Dozier, 1 ♂. GALENA: June 30, 1932, on elm, Dozier & Mohr, 1 ♀. OQUAWKA: June 13, 1932, H. L. Dozier, 1 ♀.

Lopidea media (Say)

Capsus medius Say (1832, p. 22; 1859, p. 341).

MALE.—Length 5.60, width 1.70. Orange red to bright red, scutellum and rather broad area either side of commissure more or less darkened with fuscous, reddish color

always showing through this infuscation; legs fusco-brownish to blackish; femora exhibiting one or two rows of darker spots both above and below. Clothed with short, pale pubescence; a few stiff, black hairs on scutellum. Genital claspers very distinctive for species, fig. 121.

FEMALE.—Length 5.70, width 1.80; usually colored very similarly to male, but sometimes with embolium and outer edge of cuneus pale or white as in *heidemanni* Knight.

FOOD PLANTS.—Goldenrod (*Solidago rugosa*) and several other plants. Illinois specimens were collected on spiderwort (*Tradescantia* sp.), hazelnut (*Corylus* sp.), willow (*Salix* sp.), ash (*Fraxinus* sp.) and red birch (*Betula nigra*).

KNOWN DISTRIBUTION.—A common and widely distributed species east of the Rocky Mountains.

Illinois Records. — One hundred four males and 104 females, taken May 25 to July 24, are from Champaign, Dixon Springs, Galena, Geff, Golconda, Grand Detour, Grand Tower, Hardin, Harrisburg, Havana, Homer Park, Kankakee, Keithsburg, Lilly, Muncie, Oakwood, Oquawka, Oregon, Palos Park, Princeton, Pulaski, Shawneetown, Starved Rock State Park, Urbana.

Lopidea staphyleae Knight

Lopidea staphyleae Knight (1917*d*, p. 460).

MALE.—Length 6.50, width 2.05. Antennae, first segment, length 0.71, thickness 0.15; second, 2.48, thickness 0.10, tapering to become slightly smaller on apical half; third, 1.82, slender and almost linear; fourth, 0.52. General color mostly orange yellow, with calli, narrow area at base of pronotum, scutellum, apical two-thirds of clavus, inner half of corium, and membrane, fuscous; antennae, tylus, two bars on front, base of head, rostrum, and legs, black; fuscous shading on dorsum much paler than in *robiniae* (Uhler); genital claspers, fig. 121, distinctive for species.

FEMALE.—Length 6.80, width 2.20. Similar to male in structure and coloration, but usually slightly larger; sometimes very similar in size and coloration to female of *confluenta* (Say), but length of first antennal segment in *confluenta* is shorter than width of vertex, while in *staphyleae* its length is as great as, or slightly greater than, width of vertex. Head width 1.29, vertex 0.78. Antennae, length of first segment, 0.81; second, 2.64.

Specimens in which the orange yellow areas become red constitute var. *sanguinea* Knight (1917*d*, p. 461), taken in Illinois chiefly in northern localities.

FOOD PLANT. — American bladder nut (*Staphylea trifolia*); a single Illinois specimen was collected on willow (*Salix* sp.), but that tree was probably not its host.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Kansas, Maryland, Massachusetts, Minnesota, New York, Oklahoma, South Carolina, Virginia.

Illinois Records.—Thirty-two males and 47 females, taken June 2 to Aug. 22, are from Apple River Canyon State Park, Bloomington, Decatur, Dolson, Glendon Park, Grafton, Grand Tower, Hardin, Havana, Homer Park, Kampsville, Karnak, Monticello, Parker, Seymour, Urbana, Willow Springs.

Lopidea amorphae Knight

Lopidea amorphae Knight (1923*c*, p. 65).

MALE.—Length 5.90, width 2.00. Head width 1.10, vertex 0.34. Antennae, length of first segment, 0.60; second, 2.09, thickness 0.11, tapering to become more slender on apical half; third, length 1.20; fourth, length 0.40. Pronotum, width at base 1.84. Hemelytra with red areas bearing fine, yellowish pubescence, while in *reuteri* Knight these areas bear black pubescence. Smaller than *reuteri* and more yellowish in color, majority of specimens more yellowish than red. Genital claspers, fig. 121, indicate a close relationship with *reuteri*, but in the large series examined distal portion of right clasper shows constant differences.

FEMALE.—Length 6.30, width 2.30; very similar to male in form, pubescence and coloration.

FOOD PLANT.—False indigo (*Amorpha fruticosa*); a single specimen was also taken in Illinois on red clover (*Trifolium pratense*).

KNOWN DISTRIBUTION. — Illinois, Iowa, Kansas, Minnesota, Nebraska, South Dakota, but may be expected from other states where the host plant grows in abundance.

Illinois Records.—ANNA: July 17, 1883, 1 ♀. BEARDSTOWN: June 10, 1932, Ross & Mohr, 1 ♂. GRAND TOWER: June 27, 1906, 3 ♀; June 30, 1909, sweeping from grass,

1 ♂, 1 ♀; June 1, 1913, 1 ♀. OQUAWKA: June 13, 1932, H. L. Dozier, 1 ♀. SAVANNA: July 21, 1892, from sweet clover, McElfresh, 1 ♀.

Lopidea lathyri Knight. *Emended name.*

Lopidea lathyrae Knight (1923*c*, p. 66).

MALE.—Length 5.90, width 1.90. Head width 1.11, vertex 0.65. Antennae, length of first segment, 0.65; second, 2.00, cylindrical. Pronotum, width at base 1.71. Size, form and color very suggestive of *confluenta* (Say); mostly deep red; legs, antennae, pronotal disk (except lateral and anterior margins), scutellum, broad stripe on either side of commissure, and membrane, black; clothed with fine, yellowish pubescence on red areas, but pubescence black over dark surface, with a few sericeous, yellowish hairs about margins of calli. Genital claspers, fig. 121, distinctive for species.

FEMALE.—Length 6.20, width 2.20; very similar to male, but with embolium and outer half of cuneus pale.

FOOD PLANT.—Vetchling (*Lathyrus venosus*). In Minnesota I found this species so abundant that its host plants were largely killed. This mirid may be regarded as a potenial pest of cultivated vetches.

KNOWN DISTRIBUTION.—Illinois, Manitoba, Minnesota, North Dakota, Oklahoma, Saskatchewan.

Illinois Records.—PALOS PARK: July 10, 1912, A. B. Wolcott, 3 ♂, 3 ♀, FM; July 2, 1916, W. J. Gerhard, 1 ♂, FM; July 4, 1918, W. J. Gerhard, 1 ♀, FM.

Lopidea reuteri Knight

Lopidea reuteri Knight (1917*d*, p. 459).

MALE.—Length 7.10, width 2.54. General color a vivid carmine red, with fuscous on calli, scutellum and areas bordering commissure. Very similar to *caesar* (Reuter), but with fuscous areas on corium and cuneus narrower; genital claspers, fig. 121, distinctive for species. Antennae, length of first segment, 0.65, thickness 0.17; second, length 2.42, greatest thickness 0.16, tapering from middle to become more slender at apex; third, length 1.60, linear and slender; fourth, length 0.60; black, first two segments clothed with prominent, coarse hairs; almost identical in structure with *caesar*.

FEMALE.—Length 6.90, width 2.50. Structurally and in color very similar to male; also very similar to female of *caesar*, which species rarely has calli darkened and usually has less fuscous shading on scutellum. Head width 1.17, vertex 0.71. Antennae, length of first segment 0.74, thickness 0.17; second, length 2.62, greatest thickness 0.17.

FOOD PLANT.—Witchhazel (*Hamamelis virginiana*).

KNOWN DISTRIBUTION.—Illinois, Massachusetts, Michigan, Mississippi, Missouri, Pennsylvania, Virginia, West Virginia.

Illinois Records.—GRAND TOWER: June 27, 1906, 1 ♀.

Lopidea instabilis (Reuter)

Lomatopleura instabilis Reuter (1909, p. 72).

MALE.—Length 5.40, width 2.02. Antennae black, two basal segments clothed with moderately short, black hairs; first segment, length 0.58, thickness 0.08; second, 1.80, thickness 0.07 at middle, tapering to become smaller at either end; third, length 1.19, slender; fourth, length 0.52. General color bright red, apical half of clavus and inner half of corium darkened with fuscous; membrane uniformly blackish; tibiae blackish, becoming reddish at base; genital claspers distinctive, fig. 121.

FEMALE.—Length 6.00, width 2.40; similar to male in coloration, pubescence and in structure of antennae. Head width, 1.10, vertex 0.65. Antennae, first segment, length 0.66, thickness 0.17; second, length 2.12, greatest thickness 0.17.

FOOD PLANT.—Lead plant (*Amorpha canescens*).

KNOWN DISTRIBUTION.—Missouri, Nebraska, North Dakota, South Dakota, eastward to Connecticut, southward to Mississippi, Alabama.

Illinois Records.—NORTHERN ILLINOIS: 1 ♂. LA RUE: July 11, 1935, DeLong & Ross, 4 ♀. SAVANNA: July 24, 1892, along bluff, C. A. Hart, 1 ♀.

Diaphnidia Uhler

KEY TO SPECIES

1. Head black, first antennal segment very dark................**capitata,** p. 92
   Head pale........................ 2
2. Second antennal segment pale........ ....**pellucida,** p. 92
   Second antennal segment fuscous to black...........**provancheri,** p. 92

Diaphnidia pellucida Uhler

Diaphnidia pellucida Uhler (1895, p. 44).

ADULTS.—Fig. 123. Length 4.30, width 1.40. General color uniformly pellucid, greenish white, including antennae; eyes and tips of tarsi fuscous; pubescence simple, pale.

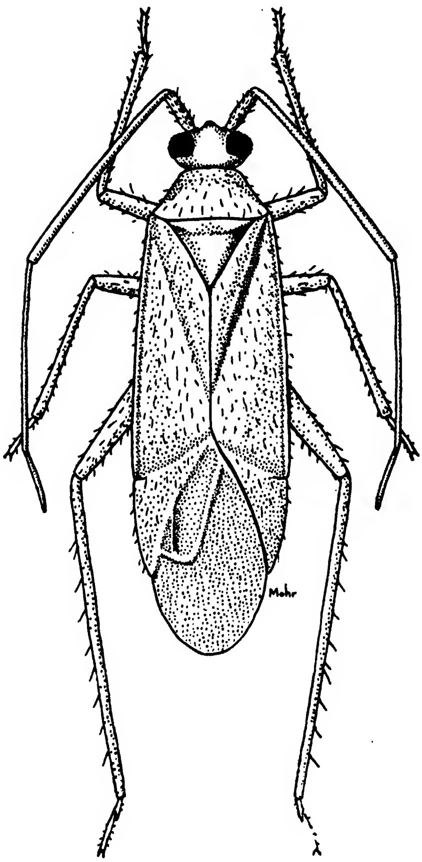


Fig. 123.—*Diaphnidia pellucida*, ♂.

HOST PLANTS. — Hawthorn (*Crataegus* sp.), apple (*Pyrus malus*), hop hornbeam (*Ostrya virginiana*) and several other trees; Illinois specimens were taken also on cottonwood (*Populus deltoides*), locust (*Robinia pseudoacacia*), oak (*Quercus* sp.), maple (*Acer* sp.), elm (*Ulmus* sp.), walnut (*Juglans nigra*), willow (*Salix* sp.) and alder (*Alnus* sp.).

KNOWN DISTRIBUTION.—Throughout the eastern United States and Canada.

Illinois Records.—Sixty-one males and 121 females, taken June 5 to Sept. 20: Danville, Eichorn, Fairfield, Galena, Galesburg, Geff, Grafton, Grand Detour, Hardin, Havana, Kansas, Marshall, Monticello, Muncie, Oakwood, Shawneetown, Urbana, Vienna, White Heath, White Pines Forest State Park.

Diaphnidia provancheri (Burque)

Malacocoris provancheri Burque (1887, p. 144).

ADULTS.—Length 4.80, width 1.40. General color pellucid greenish yellow, more green on hemelytra than elsewhere, tibiae lightly infuscated; second antennal segment fuscous to black; following segments fuscous.

HOST PLANT.—White oak (*Quercus alba*) and probably other plants.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Minnesota, New Hampshire, New York, Quebec.

Illinois Records.—MONTICELLO: June 28, 1914, 1 ♂. URBANA: Aug. 26, 1932, Harper & Park, 6 ♂; Sept. 16, 1935, DeLong & Ross, 1 ♂.

Diaphnidia capitata Van Duzee

Diaphnidia capitata Van Duzee (1912, p. 490).

ADULTS.—Length 3.00. General color pale; distinguished by its black head and fuscous to black first antennal segment; sometimes second antennal segment is also infuscated, beginning on base and apex.

HOST PLANT.—Witchhazel (*Hamamelis virginiana*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Iowa, Maine, Minnesota, New York, Ohio, Ontario.

Illinois Records.—DE SOTO: July 28, 1930, Knight & Ross, 2 ♀. DONGOLA: Aug. 3, 1916, 1 ♂. ELIZABETHTOWN: Aug. 4, 1932, H. L. Dozier, 1 ♀. METROPOLIS: July 26, 1930, Knight & Ross, 1 ♂. MONTICELLO: June 11, 1934, Frison & DeLong, 2 ♀. OAKWOOD: June 14, 1930, on ironwood, T. H. Frison, 1 ♀.

Reuteria Puton

KEY TO SPECIES

1. First antennal segment with inner black line indistinct on basal half; transverse apical portion with outer black line forming a letter **J** ....**platani**, p. 95

First antennal segment with inner black line complete, nearly parallel with outer line and both joined apically on ventral side.............. 2

2. Second antennal segment with a broad fuscous to black area.............
.... **fuscicornis**, p. 94
Second antennal segment pale, a black annulus at base; at most the black color not occupying more than basal one-fourth of segment............. 3

3. Corium, clavus and dorsal aspect of hind femora conspicuously marked with green spots...... **irrorata**, p. 93
Corium and femora without well-defined green blotches or spots....... 4

4. Second antennal segment with a rather broad, fuscous area at base, linear extent of dark color greater than width of first segment.. **querci**, p. 95
Second antennal segment with a narrow black annulus at base, width of this annulus scarcely exceeding diameter of first segment.................. 5

5. Membrane with a sharply defined, fuscous mark bordering larger areole
.... **pollicaris**, p. 95
Membrane without fuscous mark bordering larger areole..............
.... **bifurcata**, p. 94

Reuteria irrorata (Say)

Capsus irroratus Say (1832, p. 25).

MALE.—Length 4.20, width 1.30. Head width 0.69, vertex 0.35. Rostrum, length 1.18, nearly attaining posterior margins of middle coxae. Antennae, first segment, length 0.38, thicker on basal half and tapering apically, yellowish green, a heavy black longitudinal line on inner and one on outer side, these two lines connected apically across ventral aspect; second, 1.41, yellowish, a narrow black annulus at base; third, 0.91, yellowish; fourth, 0.56, dusky yellow. Pronotum, length 0.56, width at base 1.10. Clothed with moderately long, simple, white pubescence, longest on pronotum and base of hemelytra, more recumbent and partly sericeous on clavus; a tuft of fuscous hairs at tip of clavus and inner basal angle of cuneus. General coloration pale to white; hemelytra somewhat translucent; blotches and spots on corium and clavus; edge of clavus bordering scutellum, edges of cuneus, and veins in membrane, bluish green; membrane clear, a fuscous mark bordering apex of larger areole. Legs pale to yellowish green, hind femora usually with one or two green spots on dorsal aspect. Male genital claspers distinctive, fig. 124.

FEMALE.—Length 3.80, width 1.47. Head

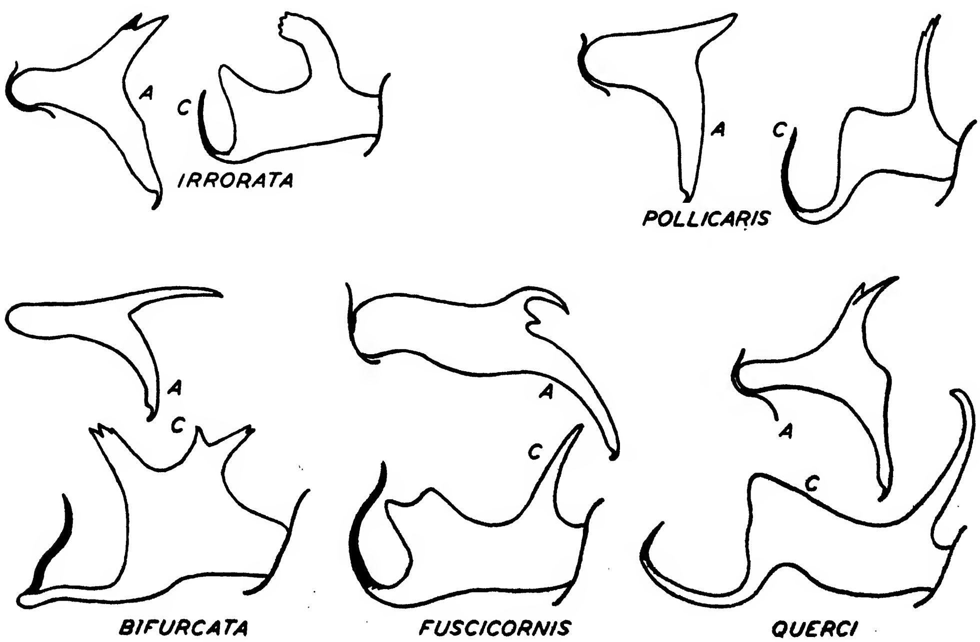


Fig. 124.—Male genital claspers of *Reuteria*. *A*, left clasper, lateral aspect; *C*, right clasper, lateral aspect.

width 0.67, vertex 0.36. Antennae, first segment, length 0.39; second 0.95; marked as in male. Slightly more robust than male, but very similar in pubescence and coloration.

Host Plants.—Chiefly on elm (*Ulmus americana*); also, two Illinois specimens were taken on cypress (*Taxodium distichum*).

Known Distribution. — Illinois, Indiana, Iowa, Minnesota, New York.

Illinois Records.—Twenty males and 34 females, taken June 24 to Aug. 11, are from Aldridge, Algonquin, Ashley, Champaign, Dubois, Galesburg, Grafton, Harrisburg, Kansas, Karnak, Monticello, Pulaski, Rockford, Starved Rock State Park, Urbana.

Reuteria bifurcata Knight

Reuteria bifurcata Knight (1939*b*, p. 130).

This is distinguished from allied species by the bifurcate form of the male genital claspers, fig. 124; it differs in color from *irrorata* (Say) and *fuscicornis* Knight in the absence of green dots on the clavus and the corium.

Male.—Length 4.80, width 1.60. Head width 0.75, vertex 0.36. Rostrum, length 1.30, reaching to middle of intermediate coxae. Antennae, first segment, length 0.44, black marks typical for genus; second, 1.69, yellowish, a distinct black ring at base; third, 1.21, yellowish to dusky; fourth, 0.69, dusky yellow. Pronotum, length 0.62, width at base 1.25. Clothed with pale, simple pubescence as in *irrorata*.

Female.—Length 4.30, width 1.65. Color and pubescence not differing from those of male.

Known Distribution.—Illinois, Maryland, New York, Oklahoma.

Illinois Record.—Shawneetown: June 27, 1936, DeLong & Mohr, 1 ♂.

Reuteria fuscicornis Knight

Reuteria fuscicornis Knight (1939*b*, p. 129).

This species is distinguished from *irrorata* (Say) by the structure of the male genital claspers, fig. 124, and the fuscous coloration of the second antennal segment.

Male.—Fig. 125. Length 4.30, width 1.30. Head width 0.65, vertex 0.55. Rostrum, length 1.21, reaching to apices of middle coxae. Antennae, first segment, length 0.43, pale, a heavy, black, longitudinal line on inner and one on outer margin, the two lines connected apically across ventral aspect; second, 1.53, blackish at base, shading to fuscous on basal half or more, yellowish apically; third, 1.17, yellowish;

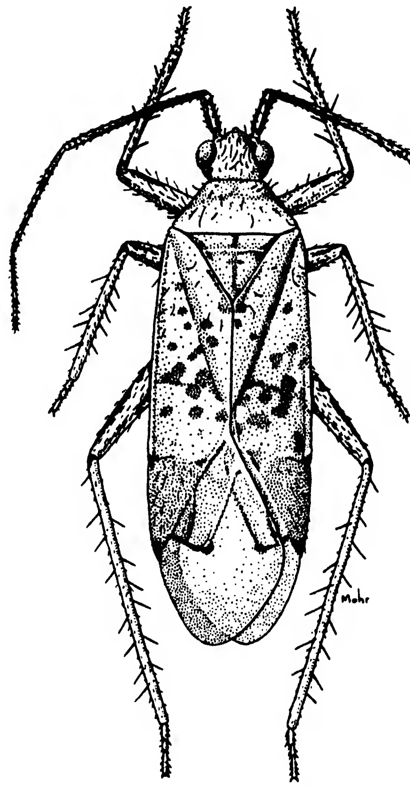


Fig. 125.—*Reuteria fuscicornis*, ♂.

fourth, 0.56, dusky. Pronotum, length 0.52, width at base 1.12. Clothed with simple pale pubescence, hairs longer on pronotum, embolium and vertex of head; a few fuscous hairs at the tip of clavus; pubescence more recumbent and silky on clavus and corium. Coloration pale to whitish, hemelytra more translucent; apex and outer basal angle of cuneus, veins at tip of membrane cells, blotch on corium near tip of clavus, bluish green. This differs from *irrorata* in having much less green on the hemelytra and femora. Ventral surface and legs pale; femora sometimes shaded with greenish but not forming distinct spots; tibiae with a black point at base.

Female.—Length 4.30. Color and pubescence not differing greatly from those of the male.

Host Plants.—Hop hornbeam (*Ostrya*

virginiana) and water beech (*Carpinus caroliniana*).

KNOWN DISTRIBUTION. — Illinois, Iowa, Minnesota, New York, Ontario.

Illinois Records. — HARRISBURG: June 25, 1932, Ross, Dozier & Park, ♂♂, ♀♀. KARNAK: June 23, 1932, Ross, Dozier & Park, 1 ♂, 1 ♀.

Reuteria querci Knight

Reuteria querci Knight (1939*b*, p. 131).

This species is allied to *irrorata* (Say), but is distinguished by the structure of the male genital claspers, fig. 124; the females of *querci* and *irrorata* may be separated by the absence in *querci* of well-formed green blotches on the corium and the presence of paler veins in the membrane.

MALE.—Length 4.30, width 1.40. Head width 0.71, vertex 0.35. Rostrum, length 1.17, reaching to near hind margins of middle coxae. Antennae, first segment, length 0.43, marked with black, as typical for genus; second, 1.51, yellowish, black at base; third, 0.95, yellowish; fourth, 0.56, dusky yellow. Pronotum, length 0.56, width at base 1.14. Clothed with pale, simple pubescence, clavus and corium with somewhat sericeous pubescence, a tuft of fuscous hairs at tip of clavus.

FEMALE.—Length 4.40, width 1.50. Coloration and pubescence similar to those of male.

HOST PLANT.—Bur oak (*Quercus macrocarpa*).

KNOWN DISTRIBUTION. — Illinois, Iowa, Maryland, Minnesota, New York, Virginia.

Illinois Records. — ALTON: June 23, 1934, DeLong & Ross, 1 ♂. DIXON SPRINGS: June 23, 1932, Ross, Dozier & Park, 1 ♂. GOLCONDA: June 22, Ross, Dozier & Park, 1 ♀. KARNAK: June 23, 1932, on *Quercus* sp., Ross, Dozier & Park, 2 ♂, 2 ♀. ROCKFORD: July 5, 1932, Dozier & Mohr, 3 ♂. URBANA: June 27, 1932, on oak, Frison & Ross, 1 ♂. WHITE HEATH: July 4, 1933, H. H. Ross, 2 ♂.

Reuteria platani new species

This is distinguished from other species of the genus by the indistinct inner black line on the first antennal segment, this black line forming a letter J on the ventral aspect.

FEMALE.—Length 4.90, width 1.64. Head width 0.73, vertex 0.41. Rostrum, length 1.42, reaching to middle of hind coxae. Antennae, first segment, length 0.43, white, inner black line indistinct on basal half, connecting portion distinct, black lines forming a distinct letter J; second, 1.77, white, a narrow black annulus at base; third, 1.12, pale; fourth, 0.65, pale. Pronotum, length 0.60, width at base 1.16. Clothed with rather long, white pubescence, longest on thorax, head and base of hemelytra, a tuft of fuscous hairs at tip of clavus and inner angle of paracuneus. General coloration pale to white, hemelytra semitranslucent, devoid of green blotches, cuneus tinged with greenish, but without spots; membrane clear, veins opaque whitish. Legs pale; femora tinged with greenish, but without spots; spot on bases of hind tibiae and at tips of tarsi black.

HOST PLANT.—Sycamore (*Platanus occidentalis*).

Holotype, female.—Snyder, Ill.: July 23, 1932, on sycamore, Dozier & Park.

Paratype.—Same data as for holotype, 1 ♀.

Reuteria pollicaris Knight

Reuteria pollicaris Knight (1939*b*, p. 131).

Not taken in Illinois; described from Mississippi. Male genital claspers as in fig. 124.

Mecomma Fieber

No Illinois species; *Mecomma gilvipes* (Stål) is known from Michigan, New York, Ontario.

Cyrtorhinus Fieber

No Illinois species; *Cyrtorhinus caricis* (Fallen) is known from Minnesota.

Melanotrichus Reuter

KEY TO SPECIES

1. Dorsum with black, scalelike pubescence, fig. 152; color chiefly deep apple green; veins green; membrane including larger areoles fuscous..... .... **althaeae, p. 96**

   Dorsum with pale, silky, glossy pubescence.......................... 2

2. Hemelytra and scutellum dusky in color; length of second antennal segment less than width of pronotum

at posterior margin.... **catulus**, p. 97

Hemelytra and scutellum greenish; length of second antennal segment greater than width of pronotum at posterior margin; membrane dusky; veins and areoles green.............................. **flavosparsus**, p. 96

Melanotrichus flavosparsus (Sahlberg)

Phytocoris flavosparsus Sahlberg (1842, p. 411).

Male.—Length 4.00, width 1.30. Head width 0.69, vertex 0.55. Antennae, first segment, length 0.28; second, 1.21. Pronotum,

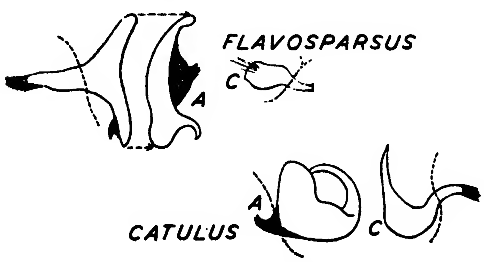


Fig. 126.—Male genital claspers of *Melanotrichus. A*, left clasper; *C*, right clasper.

length 0.45, width at base 0.95. General color clear green, becoming yellowish on callosities, head and ventral surface; membrane dusky; areoles and veins green. Clothed with simple, erect, bristlelike, fuscous pubescence, intermixed with spots of silvery, sericeous pubescence. Genital claspers as in fig. 126.

Female.—Length 4.00, width 1.50. Head width 0.80, vertex 0.43. Antennae, first segment, length 0.30; second, 1.25. Pronotum, length 0.56, width at base 1.21. Color and pubescence similar to those of male.

Food Plants.—Lamb's quarter, known likewise as pigweed (*Chenopodium album*); also, Illinois specimens were collected on hawthorn (*Crataegus* sp.), beet (*Beta vulgaris*), willow (*Salix* sp.), cypress (*Taxodium distichum*), spruce (*Picea* sp.) and sunflower (*Helianthus* sp.). Some of these records are undoubtedly accidental.

Known Distribution.—Common over the eastern United States.

Illinois Records.—One hundred forty males and 174 females, taken May 12 to Oct. 9, are from Algonquin, Alton, Alto Pass, Anna, Antioch, Arcola, Beardstown, Bloomington, Champaign, Chicago, Clayton, Colona, Delavan, Des Plaines, Dixon, Dolson, Dongola, Elizabeth, Elizabethtown, Fairmount, Forest City, Galena, Galesburg, Grafton, Grand Detour, Grand Tower, Grandview, Hatton, Havana, Kampsville, Kankakee, Karnak, Keithsburg, Meredosia, Momence, Monticello, Mount Carroll, Quincy, Rising, St. Anne, St. Joseph, Savanna, Starved Rock State Park, Tremont, Urbana, York, Zion.

Melanotrichus althaeae (Hussey)

Hollyhock Plant Bug

Orthotylus (Psallus) delicatus Cook (1891, p. 10). *Preoccupied.*

Orthotylus althaeae Hussey (1924, p. 165).

Male.—Length 4.10, width 1.30. Head width 0.75, vertex 0.39. Antennae, first segment, length 0.44; second, 1.51. Pronotum, length 0.61, width at base 1.14. General color deep apple green; calli, head and ventral surface yellowish; membrane, including areoles, fuscous; veins green. Clothed with simple, erect, pale pubescence intermixed with deciduous, black, sericeous or scalelike pubescence.

Female.—Fig. 127. Length 3.80, width 1.34. Color and pubescence similar to those of male.

Host Plant.—Cultivated hollyhock (*Al-*

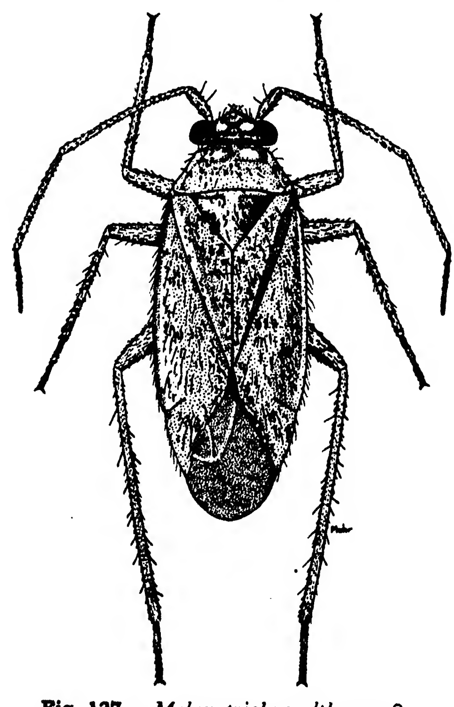


Fig. 127.—*Melanotrichus althaeae*, ♀.

thaea rosea), where it is often a pest. The nymphs and adults feed on the leaves, causing white spots to appear where the chlorophyll is removed; with severe infestation the leaves may turn yellow and dry out. In Colorado the author found this bug breeding on a wild species of *Althaea*. In Illinois it was found breeding also on mallow (*Malva rotundifolia*), a very near relative of the hollyhock.

KNOWN DISTRIBUTION.—Colorado, Illinois, Iowa; Michigan, Minnesota, Wyoming.

Illinois Records.—Sixty-three males and 68 females, taken May 31 to Sept. 30, are from Algonquin, Decatur, Galena, La Harpe, Monticello, Urbana.

Melanotrichus catulus (Van Duzee)

Orthotylus catulus Van Duzee (1916*b*, p. 106).

MALE.—Length 4.50, width 1.60. Head width 0.82, vertex 0.43. Antennae, first segment, length 0.27; second, 1.00. Pronotum, length 0.56, width at base 1.20. General color whitish to testaceo-grayish; head and calli tinged with yellowish; hemelytra sometimes slightly infuscated; membrane fumate. Clothed with simple, erect, fuscous hairs, intermixed with recumbent, silvery, glossy pubescence. Genital claspers distinctive for species, fig. 126.

FEMALE.—Length 3.90, width 1.50. Color and pubescence similar to those of male.

HOST PLANT.—Low cudweed (*Gnaphalium uliginosum*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Maine, Minnesota, New York, Ontario.

Illinois Record.—MARSHALL: May 25, 1928, T. H. Frison, 2 ♂, 4 ♀.

Orthotylus Fieber

KEY TO SPECIES

1. Ground color green; dark markings, if present, not clouding corium.... 2
   Ground color pale testaceous to black, sometimes greenish, but, in that case, hemelytra marked with fuscous and black areas, fig. 129.....11
2. Small, length not over 4.00......... 3
   Larger, length 4.50 or more......... 7
3. Rostrum not reaching posterior margin of mesosternum, extending very little beyond middle; pubescence fuscous..........**chlorionis**, p. 98
   Rostrum attaining or surpassing posterior margin of mesosternum..... 4
4. Length of second antennal segment less than three times width of vertex between eyes...**robiniae**, p. 100
   Length of second antennal segment equal to or more than three times width of vertex................ 5
5. Length of third antennal segment three-fourths length of second segment; hemelytra with soft, simple pubescence intermixed with a limited number of minute, golden, silky hairs.................**ulmi**, p. 100
   Length of third antennal segment not more than two-thirds length of second segment; hemelytra with only stiff, simple pubescence...... 6
6. Length of second antennal segment distinctly greater than width of pronotum at posterior margin; hemelytra and veins in membrane deep blue green...........**taxodii**, p. 101
   Length of second antennal segment not exceeding width of pronotum at posterior margin; hemelytra and veins of membrane yellowish green, veins often pale......**ramus**, p. 100
7. Tylus with small fuscous spot at base. 8
   Tylus without small fuscous spot at base.......................... 9
8. Membrane pale, darkest specimens pale fuscous; clavus never infuscated............**viridis**, p. 101
   Membrane uniformly dark fuscous or black; clavus sometimes with a dusky cloud...................
   modestus var. **immaculatus**, p. 104
9. Length of second antennal segment twice width of head across eyes; first antennal segment fuscous; length 5.70......**basicornis**, p. 102
   Length of second antennal segment less than twice width of head across eyes..........................10
10. Length 5.80–6.10; rostrum extending upon middle coxae; first antennal segment may be fuscous to black beneath, but always paler above.... ....**rossi**, p. 102
    Length 6.70–7.30; rostrum just attaining posterior margin of mesosternum; first antennal segment uniformly black.......**notabilis**, p. 100

11. Ground color green, apical half of clavus, spot on apical half of corium, and broad spot or vitta either side of pronotal disk behind calli, black; length 6.70–7.00 (male)............................ **notabilis**, p. 100
    Ground color not green, or, if so, then length less than 6.50........12
12. Pronotal disk partly orange colored; sometimes hemelytra also partly orange.........................13
    Pronotal disk without orange coloring.............................14
13. Hemelytra chiefly orange or salmon colored; black either side of commissure and on embolium...................**submarginatus**, p. 103
    Hemelytra black; a broad, pale stripe extending full length of corium and connecting with pale cuneus; legs fulvous; apical halves of hind femora black........**knighti**, p. 102
14. General color pale yellow brown, hemelytra translucent and with fuscous markings very faint or nearly lacking in female; median line of head and scutellum, lateral margins of pronotum, and sides of body, black; antennae black; membrane slightly infuscated, veins brown.........................**candidatus**, p. 102
    Ground color sometimes pale greenish or yellowish, but dark markings of hemelytra distinct; other markings not as above...................15
15. Cuneus black, slightly translucent at base; dorsum blackish; slender, pale areas present only at base of corium and of embolium; pale median line present on pronotal disk, this line sometimes continued upon scutellum; length 6.80............................**necopinus**, p. 103
    Cuneus pale, or fuscous on inner half only; length not over 6.00........16
16. Lateral margins of pronotal disk and propleura, except ventral margin, black; median area of disk and scutellum pale..................17
    Pronotum with different coloring....18
17. Length of female second antennal segment slightly greater than twice the width of head across eyes; for males see figure of genital claspers, fig. 128............**nyctalis**, p. 104
    Length of female second antennal segment scarcely equal to twice the width of head across eyes; for males see figure of genital claspers, fig. 128..................**lateralis**, p. 104
18. Length of second antennal segment less than twice width of head across eyes...........................19
    Length of second antennal segment twice width of head across eyes....20
19. Legs green or yellowish, not infuscated; light-colored areas of dorsum greenish or fading to yellowish, never tinged with salmon........**modestus** var. **modestus**, p. 104
    Legs pale to greenish, but hind femora fuscous on apical half; light-colored areas of dorsum tinged with salmon........**ornatus**, p. 103
20. Female calli with outer half black; male genital claspers as in fig. 128.........................**serus**, p. 102
    Female calli, at least the outer half, pallid; for males see figures of genital claspers......................21
21. Juga black; smaller, length 5.20........................**dorsalis**, p. 100
    Juga yellowish; larger, length 5.80.....................**neglectus**, p. 105

Orthotylus chlorionis (Say)

Capsus chlorionis Say (1832, p. 25; 1859, p. 346).

This species is distinguished by its small size, short rostrum, green color and simple, fuscous pubescence.

MALE.—Length 3.70, width 1.25. Rostrum, extending very slightly beyond middle of mesosternum, green, apex black. Antennae, greenish yellow, last two segments dusky to fuscous. General color green, head and ventral surface yellowish; membrane pale, veins green. Clothed with simple, short, fuscous pubescence, this paler on embolium. Male genital claspers distinctive, fig. 128.

FEMALE.—Length 3.80, width 1.40. Head width 0.73, vertex 0.38. Antennae, first segment, length 0.30; second, 1.04; third, 0.90; fourth, 0.31. Pronotum, length 0.51, width at base 1.12. More robust than male, but very similar in color and pubescence.

HOST PLANTS.—Honey locust (*Gleditsia triacanthos*) and black locust (*Robinia pseudoacacia*).

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Indiana,

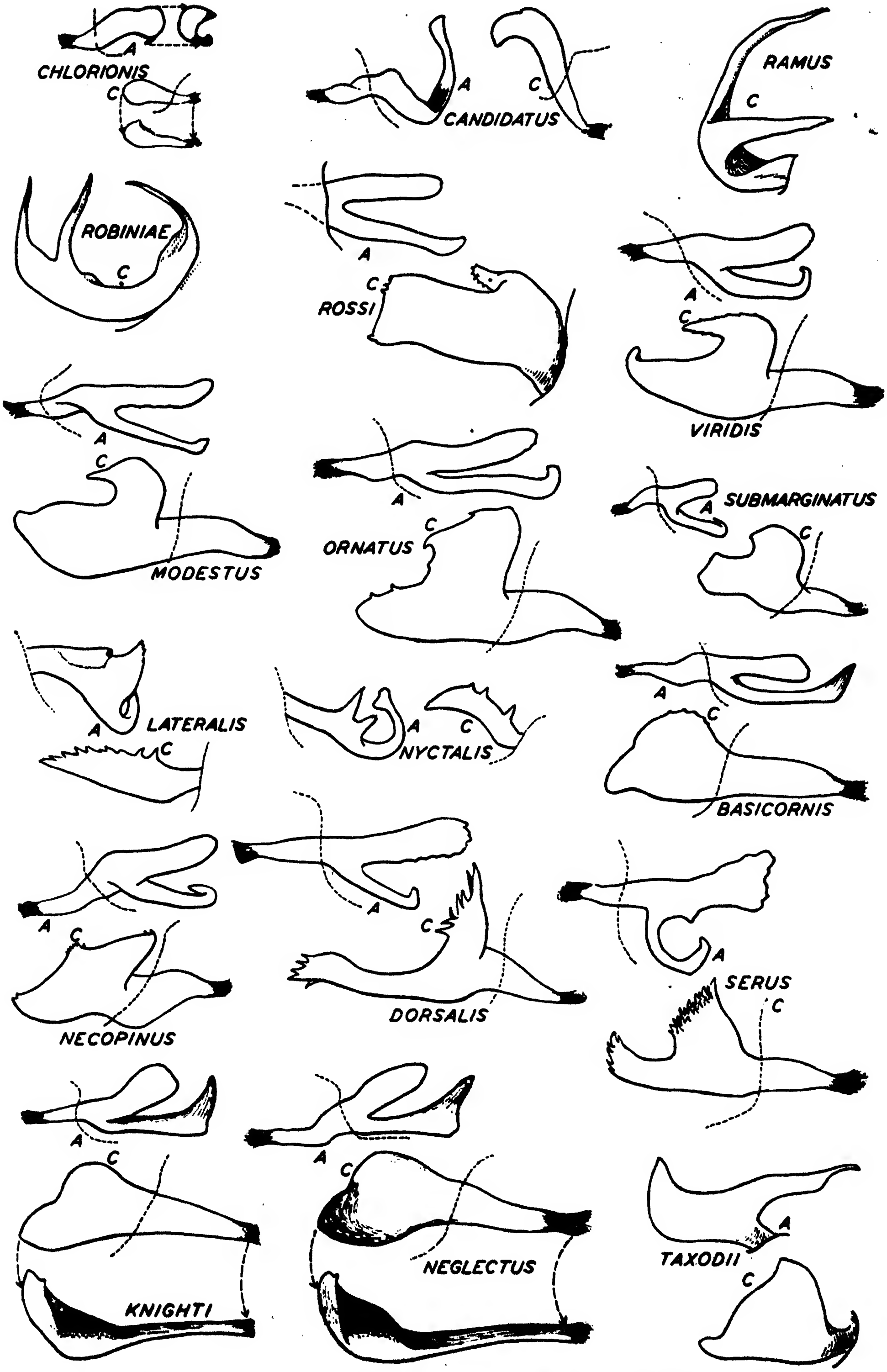


Fig. 128.—Male genital claspers of *Orthotylus*. *A*, left clasper, lateral aspect; *C*, right clasper, lateral aspect.

Iowa, Mississippi, Ohio, Texas, Virginia.

Illinois Records.—ELIZABETHTOWN: May 27-31, 1932, on *Robinia pseudoacacia,* H. L. Dozier, 24 ♀. MASON CITY: June 2, 1933, C. O. Mohr, 3 ♂, 9 ♀. MUNCIE: June 8, 1917, 1 ♀. OAKWOOD: June 14, 1930, T. H. Frison, 1 ♀. WHITE HEATH: May 30, 1915, 1 ♂.

Orthotylus ramus Knight

Orthotylus ramus Knight (1927*e*, p. 178).

This species is suggestive of *chlorionis* (Say), but is somewhat larger, with pale yellowish pubescence.

MALE.—Length 3.90, width 1.50. Eyes and shape of head about as in female of *chlorionis.* Antennae yellowish green, last segment dusky. General color uniformly green or yellowish green, membrane pale, veins green. Genital structures distinctive, fig. 128, right clasper forked near base and forming two long, curved, acuminate arms; dorsal margin of genital segment with a strong chitinous spine projecting posteriorly.

FEMALE.—Length 4.10, width 1.54. Very similar to male in form, pubescence and coloration.

HOST PLANTS.—Hickory (*Carya* sp.) and pecan (*Carya illinoensis*); according to Johnston these insects feed largely on the catkins or male flowers and but very little on the pistillate flowers. A single specimen was taken in Illinois on wild grape (*Vitis* sp.), but that record is probably accidental.

KNOWN DISTRIBUTION.—Georgia, Illinois, Iowa, Michigan, Mississippi, New York, Texas.

Illinois Records.—DANVILLE: June 8, 1902, Titus & Kahl, 1 ♀. ELIZABETHTOWN: May 27-31, 1932, H. L. Dozier, 2 ♂, 5 ♀. MASON CITY: June 2, 1933, C. O. Mohr, 5 ♂, 10 ♀. MONTICELLO: June 11, 1934, Frison & DeLong, 2 ♂. MOUND CITY: May 24, 1932, H. L. Dozier, 2 ♂, 4 ♀. MOUNDS: May 23, 1932, on wild grape, H. L. Dozier, 1 ♂. SPRINGFIELD: June 27, 1885, in woods, C. A. Hart, 1 ♂.

Orthotylus robiniae Johnston

Orthotylus robiniae Johnston (1935, p. 15).

MALE.—Length 3.60, width 1.30. Rostrum slightly surpassing hind margin of mesosternum. Antennae yellowish green, last two segments dusky. General color uniformly green or yellowish green; membrane pale to dusky, veins green. Clothed with simple, pale to yellowish pubescence. Genital claspers distinctive, fig. 128; right clasper forked near apex, forming two short, flattened, acuminate arms curving inward and upward to near middle of genital segment, the apex of each flattened and with short, blunt teeth; dorsal margin of genital segment with a slender chitinous spine projecting postero-ventrally.

FEMALE.—Length 3.60, width 1.47. More robust than male, but very similar in color and pubescence.

HOST PLANT.—Black locust (*Robinia pseudoacacia*).

KNOWN DISTRIBUTION.—Described from Mississippi and now recorded from Illinois.

Illinois Records.—EICHORN: June 13, 1934, Hicks Branch, DeLong & Ross, 1 ♂. FAIRFIELD: June 12, 1934, DeLong & Ross, 2 ♂. MASON CITY: June 2, 1933, C. O. Mohr, 1 ♂.

Orthotylus notabilis Knight

Orthotylus notabilis Knight (1927*e*, p. 176).

Not taken in Illinois; known from Iowa, Kansas, Minnesota, South Dakota; Saskatchewan. Host unknown.

Orthotylus ulmi Knight

Orthotylus ulmi Knight (1927*e*, p. 179).

Not taken in Illinois; known from Minnesota and New York; breeds on elm (*Ulmus* sp.) and should eventually be found in Illinois.

Orthotylus dorsalis (Provancher)

Lygus dorsalis Provancher (1872, p. 104).

MALE.—Length 4.90, width 1.50. Rostrum reaching upon bases of middle coxae. Form elongate, costal margins of hemelytra nearly parallel. General color black. Cuneus, embolium, base of corium, and rather broad area along radius, greenish translucent; median line of pronotum frequently paler; rostrum, except apex, and legs, green; coxae paler; membrane fuscous, veins slightly paler. Genital claspers as in fig. 128.

FEMALE.—Fig. 129. Length 5.20, width 1.60. Pale green to greenish yellow; juga, arc or spot on either side of front, stripe either side of median line, stripe extending from inner basal angles of calli to basal margin of disk, scutellum except median line

(usually), all but base of clavus and large spot on inner apical angles of corium, dark fuscous to black; pale area of corium extending along claval suture and thus tending to separate dark apical area from that of

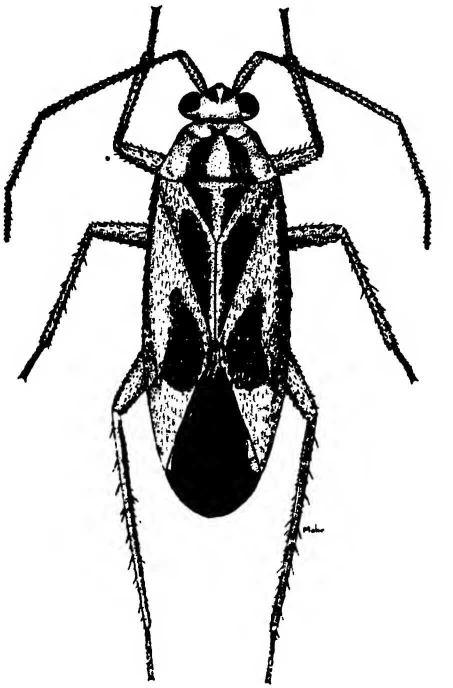


Fig. 129.—*Orthotylus dorsalis*, ♀.

clavus; membrane infuscated, veins distinctly paler. Legs green, femora yellowish; tip of rostrum and apices of tarsi blackish.

HOST PLANT.—Willow (*Salix* sp.).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Maine, Michigan, Minnesota, New York, Ohio, Ontario, Quebec.

Illinois Records.—NORTHERN ILLINOIS: 4 ♀. ANTIOCH: July 5-7, 1932, Frison *et al.*, 1 ♂, 2 ♀. FREEPORT: July 2, 1917, 1 ♀. GRANDVIEW: June 24, 1932, Frison & Mohr, 1 ♂.

Orthotylus taxodii new species

This species is allied to *robiniae* Johnston, but is distinguished by the longer second antennal segment.

MALE.—Length 3.30, width 1.10. Head width 0.62, vertex 0.30. Rostrum reaching to bases of hind coxae. Antennae yellowish green, with pale pubescence; last two segments fuscous; length of first segment 0.26; second, 1.00, cylindrical, nearly equal to thickness of first; third, 0.54; fourth, 0.30. General color green; with mesoscutum, calli and vertex yellowish; hemelytra slightly translucent; cuneus uniformly green like corium; membrane pale fumate, veins green. Clothed with simple, pale yellowish pubescence. Legs yellowish green; tibial spines dark. Genital claspers distinctive for species, fig. 128.

FEMALE.—Length 3.40, width 1.20. Slightly more robust than male, but very similar in color and pubescence. Head width 0.64, vertex 0.34. Antennae, first segment, length 0.27; second, maximum width, 1.14, tapering to become more slender on basal half; third, length 0.56; fourth, length 0.37. Pronotum, length 0.48, width at base 1.00.

HOST PLANT.—Bald cypress (*Taxodium distichum*).

Holotype, male.—Grantsburg, Ill., June 22, 1932, on cypress, Ross, Dozier & Park.

Allotype, female.—Same data as for holotype.

Paratypes. — ILLINOIS. — Same data as for holotype, 7 ♂, 36 ♀. ELIZABETHTOWN: June 22-24, 1932, Ross, Dozier & Park, 2 ♀. GOLCONDA: June 22, 1932, Ross, Dozier & Park, 6 ♀. KARNAK: June 14, 1934, on cypress, DeLong & Ross, 12 ♂, 26 ♀. SHAWNEETOWN: June 14, 1934, DeLong & Ross, 1 ♀.

Orthotylus viridis Van Duzee

Orthotylus viridis Van Duzee (1916*b*, p. 103).

MALE.—Length 4.60, width 1.50. Rostrum reaching to middle of intermediate coxae. Antennae dusky yellow, last two segments pale fuscous. General color green; head, pronotum anteriorly, embolium, and femora, yellowish; base of tylus with a small fuscous spot; membrane pale to fumate. Clothed with simple, recumbent, pale pubescence. Genital claspers as in fig. 128.

FEMALE.—Length 4.80, width 1.55. Slightly more robust than male, but very similar in color and pubescence.

HOST PLANT.—Black willow (*Salix nigra*) and perhaps other willows.

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Iowa, Maryland, Michigan, Mississippi, New York, North Carolina, Ohio, Pennsylvania, Quebec, Tennessee, Virginia.

Illinois Records.—Sixty-three males and 60 females, taken June 14 to Aug. 1, are

from Elizabethtown, Galesburg, Golconda, Grand Detour, Herod, Kansas, Rockford, St. Joseph, Savanna, Starved Rock State Park, White Heath.

Orthotylus candidatus Van Duzee

Orthotylus candidatus Van Duzee (1916*b*, p. 124).

Not taken in Illinois; known from Minnesota, New Hampshire, New York; breeds on American aspen (*Populus tremuloides*). Male claspers as in fig. 128.

Orthotylus knighti Van Duzee

Orthotylus knighti Van Duzee (1916*b*, p. 121).

Not taken in Illinois; known from Indiana, New York, Ohio; breeds on American aspen (*Populus balsamifera*) and balm of Gilead (*P. candicans*). Male claspers as in fig. 128.

Orthotylus serus Van Duzee

Orthotylus serus Van Duzee (1921, p. 131).

MALE.—Length 5.30, width 1.58. General color black; median line of pronotal disk and scutellum pale; embolium, outer margin of corium and cuneus pale greenish, translucent; genae, gula, bucculae, rostrum except apex, sternum, and legs, greenish yellow; membrane and veins uniformly dark fuscous. Male genital claspers as in fig. 128.

FEMALE.—Length 5.56, width 1.61; very similar to male in form and coloration; hemelytra with costal margins nearly parallel; sometimes the pronotal disk, vertex and front bordering eyes with broader pale mark than in male.

HABITS.—Breeds on hawthorns (*Crataegus punctata* and *C. tomentosa*).

KNOWN DISTRIBUTION. — Illinois, Iowa, New York.

Illinois Record.—FRANKFORT: June 8, 1933, on *Crataegus tomentosa,* Mohr & Townsend, 19 ♂, 32 ♀.

Orthotylus basicornis Knight

Orthotylus basicornis Knight (1923*d*, p. 515).

MALE.—Length 5.60, width 1.66. Rostrum reaching to middle of intermediate coxae. Antennae with first segment black, second yellowish to pale fuscous, third pale fuscous, fourth fuscous. General color green; embolium and outer edge of corium yellowish green; membrane pale, veins green. Clothed with prominent, suberect, rather coarse, pale pubescence. Suggestive of *viridis* Van Duzee, but distinguished by the black, first antennal segment and structure of the male genital claspers, fig. 128.

FEMALE.—Length 5.60, width 1.70. Very similar to male in form, color and pubescence.

HOST PLANT. — Sandbar willow (*Salix longifolia*).

KNOWN DISTRIBUTION. — Illinois, Indiana, Iowa, Michigan, Minnesota, New York, Quebec, South Dakota.

Illinois Records.—Thirty-nine males and 30 females, taken June 9 to Aug. 24, are from Antioch, Beardstown, Bureau, Fulton, Freeport, Galena, Grand Detour, Kampsville, Keithsburg, McHenry, Normal, Oquawka, Quincy, Savanna, Urbana, Warsaw, Waukegan, West Union.

Orthotylus rossi new species

This species is allied to *basicornis* Knight, but differs in its shorter second antennal segment; the first segment is always paler or greenish above; the structure of the male genital claspers is distinctive, fig. 128. *Orthotylus rossi* is also allied to the western species, *fuscicornis* Knight, but differs in being larger, having a longer first antennal segment and short, recumbent pubescence, and in details of the genital claspers.

MALE.—Length 6.10, width 1.80. Head width 1.18, vertex 0.43. Rostrum, length 1.56, extending slightly beyond middle of intermediate coxae. Antennae, first segment, length 0.56, fuscous to black beneath, yellowish to green above; second, 1.95, yellowish green, length less than twice width of head; third, 1.08, fuscous; fourth, 0.56, fuscous. Pronotum, length 0.99, width at base 1.65. Clothed with rather short, recumbent, pale pubescence. General color uniformly yellowish green to clear green; eyes, first antennal segment beneath, tip of rostrum, and tips of tarsi, blackish; membrane pale, veins yellowish to greenish. Genital claspers distinctive, right clasper differs from that of *basicornis* by having a broad, truncated apex.

FEMALE.—Length 6.30, width 2.16. Head width 1.12, vertex 0.56. Antennae, first segment, length 0.54, fuscous to blackish beneath; second, 1.86; third, 1.08; fourth,

0.56. Pronotum, length 1.08, width at base 1.78. More robust than male, but very similar in color and pubescence.

HOST PLANT.—Willow (*Salix* sp.).

Holotype, male.—Warsaw, Ill.: June 9, 1932, on *Salix* sp., Ross & Mohr.

Allotype, female.—Same data as for holotype.

Paratypes. — ILLINOIS. — Same data as for holotype, 5 ♂, 5 ♀. CHAMPAIGN: June 15, 1888, at light, C. A. Hart, 1 ♀. GRAND TOWER: June 27, 1906, on willow, C. A. Hart, 7 ♂, 13 ♀. KAMPSVILLE: June 25, 1932, Frison, Betten & Ross, 2 ♂. KEITHSBURG: June 8, 1932, on *Salix* sp., Ross & Mohr, 2 ♂. SAVANNA: July 23, 1892, on sandbar in Mississippi River, McElfresh, Hart & Forbes, 1 ♂, 2 ♀.

IOWA.—AMES: Aug., 1940, 1 ♀. COUNCIL BLUFFS: July 16, 1940, 1 ♂. DAVENPORT: June 27, 1940, 3 ♂. DUBUQUE: June 27, 1 ♂; July 5, 1 ♂; July 9, 1940, 1 ♂. MUSCATINE: July 27, 1940, trap light, 1 ♂. All Iowa paratypes, KC.

Orthotylus necopinus Van Duzee

Orthotylus necopinus Van Duzee (1916*b*, p. 125).

MALE.—Length 6.60, width 2.11. General color brownish black; juga, vertex, area extending along front of eyes, median line of pronotal disk and frequently anterior part of median line of scutellum, base of embolium, slender area at base of radius, areas bordering cuneal fracture, pale to pale translucent; basal half of venter, and coxae, pale; femora and tibiae testaceous to fuscous; genital claspers, fig. 128, distinctive for species.

FEMALE.—Length 6.80, width 2.20; very similar to male, but frequently with pale areas broader.

HOST PLANT.—Yellow birch (*Betula lutea*) in cool, damp, shaded situations.

KNOWN DISTRIBUTION. — Illinois, New Hampshire, New York, Ontario.

Illinois Record. — NORTHERN ILLINOIS, UI.

Orthotylus submarginatus (Say)

Capsus submarginatus Say (1832, p. 23; 1859, p. 244).

MALE.—Length 4.60, width 1.33. Dorsum pale salmon to orange; antennae, front of head, lateral margins of pronotal disk, scutellum, rather broad area on either side of commissure, embolium, area at apex of corium, apex of cuneus, and membrane, blackish or black; rostrum, except apex, pale; legs mostly pale, with hind femora dusky and tibiae almost black. Genital claspers as in fig. 128.

FEMALE.—Length 4.80, width 1.44; very similar to male, but salmon yellow areas more broad above; venter white with dorsolateral margins black; ostiolar peritreme fuscous, epimera and sternum blackish.

HOST PLANT. — Black locust (*Robinia pseudoacacia*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Indiana, Maryland, Missouri, New York, Ohio, Pennsylvania, Virginia.

Illinois Records.—BLUFF SPRINGS: June 10, 1932, Ross & Mohr, 1 ♀. MCCLURE: June 25, 1931, Frison, Betten & Ross, 1 ♀.

Orthotylus ornatus Van Duzee

Orthotylus ornatus Van Duzee (1916*b*, p. 122).

MALE.—Length 5.60, width 1.78. Rostrum extending to bases of middle coxae. Body clothed with moderately short, recumbent, simple, pale yellowish pubescence. General color black or very dark brown; tip of scutellum, basal angles of corium, and cuneus, pale to pale translucent; membrane fuscous, veins and spot on middle of apical half slightly paler; legs pale to dusky, front and middle femora very dark brown, posterior pair darker. Genital claspers as in fig. 128.

FEMALE.—Length 6.00, width 2.05. General color chiefly pale, tinged with reddish, varied with fuscous. Base of tylus and spot just above, sometimes an arc on front, basal margins of calli, pronotal disk, except median line and lateral margins, basal angles of scutellum, apical half of corium, and part of clavus, fuscous to blackish; antennae pale fusco-brownish, first segment darker; hind femora very dark brown. Sometimes this sex may have blackish areas broader and paler parts not at all tinged with reddish.

HOST PLANT.—Crack willow (*Salix fragilis*).

KNOWN DISTRIBUTION.—Colorado, Connecticut, Illinois, Indiana, Iowa, Minnesota, New York, Ohio, Ontario, South Dakota, Texas.

Illinois Records.—Eight males and 11 females, taken May 14 to July 8, are from

Algonquin, Antioch, Apple River Canyon State Park, Dubois, Elizabeth, Galena, Meredosia, Muncie, Oregon, Valley City.

Orthotylus nyctalis Knight

Orthotylus nyctalis Knight (1927*e*, p. 181).

This species is very similar to *lateralis* Van Duzee in color, but its form is more slender; the two differ chiefly in the structure of the male genital claspers.

MALE.—Length 5.10, width 1.40. Rostrum extending slightly beyond middle of intermediate coxae. Antennae very dark fuscous, with second segment uniformly dusky yellow. Coloration nearly as in *lateralis*, but darker. Clothed with simple, suberect, bristly, pale hairs. Ground color pale, with lateral margins of pronotal disk, dorsal halves of propleura, and all but narrow area at apex of first antennal segment, black; outer half of corium, base of clavus, apical half of cuneus, episterna, and dorso-lateral margins of venter, fuscous to blackish; membrane pale fuscous with veins and narrow areas of membrane bordering veins, clear. Genital claspers as in fig. 128.

FEMALE.—Length 4.80, width 1.64. Antennae dusky yellow, third segment pale to dusky, fourth dusky. More robust than male, but very similar in color and pubescence.

KNOWN DISTRIBUTION. — Illinois, Iowa, Minnesota, New York, Wisconsin.

Illinois Records. — OAKWOOD: July 5, 1936, Mohr & Burks, 1 ♀. WILLOW SPRINGS: July 21, 1912, on poplar, W. J. Gerhard, 1 ♀, KC.

Orthotylus lateralis Van Duzee

Orthotylus lateralis Van Duzee (1916*b*, p. 120).

MALE.—Length 4.60, width 1.47. Head pale yellowish, frons and tylus blackish. Rostrum, length 1.30, extending upon tips of middle coxae, yellowish, apex black. Antennae with first segment black; second cylindrical, black, clothed with fine, short, dusky pubescence; third and fourth black. Pronotum black; ventral margins of propleura pallid; disk behind calli and the anterior margin, pale to yellowish; calli brownish to black. Scutellum pallid, lateral margins narrowly fuscous; mesoscutum yellowish to fuscous. Hemelytra dark fuscous; base of corium, embolium and base of cuneus pale translucent. Membrane and veins pale fuscous, central area paler. Body beneath pale to yellowish; sides of thorax and venter dark fuscous. Dorsum clothed with simple, suberect, pale to dusky pubescence. Legs pale greenish; apical half of hind femora fuscous; tibiae dusky; tarsi fuscous.

FEMALE.—Length 4.80, width 1.50. More robust than the male; similar in color but pallid areas more extensive.

KNOWN DISTRIBUTION.—Described from Colorado and since recognized from Illinois, Iowa, Minnesota and Oklahoma.

Illinois Records.—GALESBURG: July 16, 1892, on "cottonwood," Stromberg, 3 ♀. MONTICELLO: June 28, 1914, C. A. Hart, 1 ♀.

Orthotylus modestus Van Duzee

Orthotylus modestus Van Duzee (1916*b*, p. 109).

MALE.—Length 4.40, width 1.44. Rostrum reaching to middle of intermediate coxae. Antennae fusco-brownish, first segment darker. General color fuscous to blackish. Head and paler parts of hemelytra tinged with yellowish; embolium pale, base of corium, rather broad area along radius, and cuneus, greenish yellow; membrane uniformly infuscated, veins scarcely paler. Body clothed with moderately prominent, simple, pale yellowish pubescence. Genital claspers distinctive for species, fig. 128.

FEMALE.—Length 4.50, width 1.47. General color pale greenish. Legs darker; dorsum marked with blackish; spot at base of tylus, transverse mark across bases of calli, mark paralleling basal margin of pronotal disk which approaches but does not attain lateral angles, basal angles and median spot at base of scutellum, all but basal angles of clavus, and spot on inner apical angle of corium, fuscous to black; membrane uniformly dark fuscous.

The black markings vary greatly in extent and intensity, in some cases being indistinct or absent. The uniformly green-colored specimens of this species constitute the variety *immaculatus* Knight (1923*d*, p. 520).

HOST PLANTS.—Willows (*Salix fragilis* and *S. nigra*).

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Indiana, Iowa, Michigan, Minnesota, New Jersey, New York, Ohio, Ontario, Pennsylvania.

Illinois Records.—Eighty-nine males and 106 females, taken May 22 to Aug. 1, are from Alton, Antioch, Beardstown, Bureau, Danville, Decatur, Elizabethtown, Freeport, Galena, Galesburg, Golconda, Grand Detour, Grand Tower, Hardin, Havana, Herod, Homer, Keithsburg, Mahomet, Marshall, Monticello, Mount Carmel, Oquawka, Oregon, Quincy, Quiver Lake, Rockford, St. Joseph, Savanna, Seymour, Springfield, Urbana, Warsaw, White Heath.

Orthotylus neglectus Knight

Orthotylus neglectus Knight (1923*d*, p. 515).

MALE.—Length 5.40, width 1.75. In color pattern similar to *dorsalis* (Provancher), but genital claspers, fig. 128, indicate it is more closely related to *basicornis* Knight and *knighti* Van Duzee. Color black, rostrum except apex, slender lateral margin of pronotal disk, cuneus, embolium, and outer margin of corium, greenish; legs greenish, darkened at bases of coxae and tips of tarsi; membrane and veins uniformly blackish. Rarely, pale forms may occur having median line of pronotum and scutellum pale.

FEMALE.—Length 5.80, width 1.90; more robust than the male, usually pale areas more extensive.

FOOD PLANT.—Black willow (*Salix nigra*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, New York, Nova Scotia.

Illinois Record. — ANTIOCH: June 12, 1936, Ross & Burks, 1 ♂.

Noctuocoris Knight

No Illinois species; *Noctuocoris fumidus* (Van Duzee) occurs from Colorado eastward to New York and Massachusetts. It will likely be found in Illinois eventually.

Labopidea Uhler

KEY TO SPECIES

1. Pubescence very short, recumbent, with just a few odd, erect, fuscous hairs scattered over pronotum and mesoscutum.........**ainsliei,** p. 105
   Pubescence prominent, dorsum clothed with erect, pale hairs............ 2
2. Anterior margin of pronotum not raised above flat surface of the disk. ....**planifrons,** p. 105
   Anterior margin of pronotum and calli slightly arched, raised above flat, central area of disk......**allii,** p. 105

Labopidea planifrons Knight

Labopidea planifrons Knight (1928*a*, p. 234).

Not taken in Illinois; known from Iowa and South Dakota.

Labopidea ainsliei Knight

Labopidea ainsliei Knight (1928*a*, p. 235).

This species is allied to *allii* Knight, but differs in having a wider vertex, shorter pubescence and pale yellowish green color; *ainsliei* is also distinguished by the form of the male genital claspers.

MALE.—Length 3.50, width 1.15. Antennae, greenish yellow, last two segments brownish. Body clothed with very short, fine, pale pubescence; a few silvery, silky hairs also evident on pronotum. General color greenish yellow, hemelytra more green, but not blue green as in perfect specimens of *allii*; membrane and veins evenly shaded with pale fumate. Genital claspers distinctive, left clasper more slender than in *allii*, basal lobe produced above to form an acuminate spine; right clasper slender, widened at base to form a dorsal, subtriangular lobe; apical half slender, incurved and acuminate.

FEMALE.—Length 3.50, width 1.34. More robust than male, but very similar in color and pubescence.

HOST PLANTS.—Wild onion (*Allium cernuum*) and cultivated onions in Iowa.

KNOWN DISTRIBUTION. — Illinois and Iowa.

Illinois Records. — FOUNTAIN BLUFF: May 15, 1932, Frison, Ross & Mohr, 1 ♂. GIANT CITY STATE PARK: May 21, 1932, H. L. Dozier, 1 ♂. MUNCIE: June 10, 1919, 1 ♂.

Labopidea allii Knight

Onion Plant Bug

Labopidea allii Knight (1923*b*, p. 31).

This is a small, blue green species with fine, erect, simple, pale pubescence, figs. 130, 131.

MALE.—Length 4.00, width 1.28. Head width 0.86, vertex 0.49. Rostrum, length 0.75, scarcely reaching to middle of sternum.

Antennae, first segment, length 0.34; second, 1.05, yellowish brown, green at base; third, 1.01, dusky brown; fourth, 0.43, fuscous. Pronotum, length 0.48, width at base 1.08; disk rather flat, anterior margin and calli slightly arched. Body clothed with fine, erect, simple, pale hairs, this pubescence longest on clavus, base of embolium, margins of pronotum, and frons; on pronotum and hemelytra minute, silvery, sericeous hairs which shine in certain lights also present. General color a pale blue green; antennae, except first segment, brownish; membrane uniformly pale fumate, veins about smaller areole green; tip of rostrum black. Male genital claspers distinctive for species, fig. 132.

Fig. 130.—*Labopidea allii*, the long-winged form.

FEMALE.—Length 4.10, width 1.48. More robust than male, but very similar in color and pubescence. Brachypterous females are at hand from Iowa; in these the last two segments of abdomen are exposed, cuneus short and membrane lacking.

HOST PLANTS.—Wild garlic (*Allium canadense*) and wild onion (*Allium cernuum*); this species often migrates to cultivated onions, where it becomes exceedingly abundant, often killing the plants. In southern Missouri from 1934 to 1936, many plantings of Bermuda onions were destroyed. *Labopidea allii* is also reported as a pest in southern Iowa and eastern Kansas. The bug winters as an egg in old onion stems. Destroying the old onion tops and eradicat-

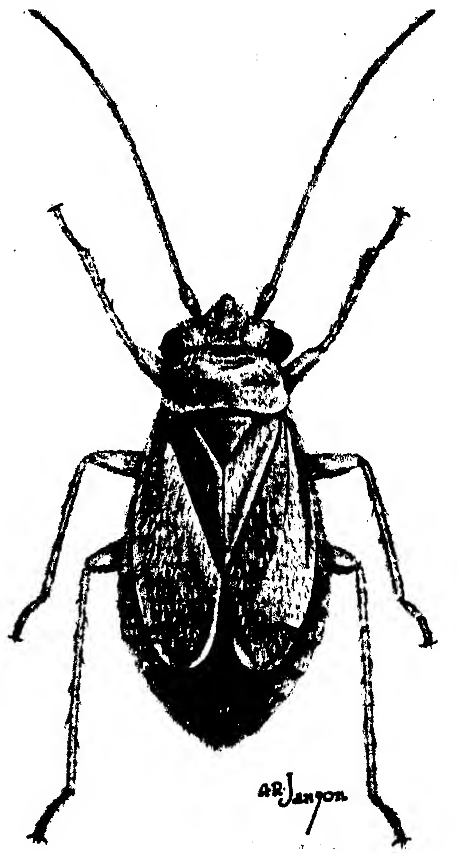


Fig. 131.—*Labopidea allii*, the short-winged form.

ing the nearby stands of the wild host should keep the pest under control.

KNOWN DISTRIBUTION. — Illinois, Indiana, Iowa, Kansas, Missouri, Oklahoma.

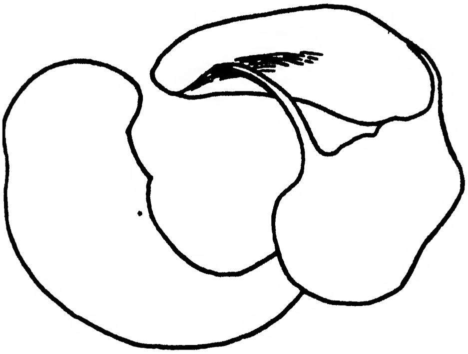


Fig. 132.—Male genital claspers of *Labopidea allii.*

Illinois Records.—Sixteen males and 15 females, taken May 7 to October, are from Green County, Alto Pass, Anna, Cache, Cobden, Dongola, Elizabethtown, Fountain Bluff, Grand Tower, Olney, Rattlesnake Ferry, Urbana.

Heterocordylus Fieber

Heterocordylus malinus Reuter

Heterocordylus malinus Reuter (1909, p. 71).

MALE.—Length 6.20, width 2.20. Head width 1.12, vertex 0.58. Antennae, first segment, length 0.47; second, 1.80, maximum thickness equal to that of first segment, pubescence prominent, black; third, length 0.73, moderately slender; fourth, length 0.52, slender. Pronotum, length 1.12, width at base 1.95. General color black, usually with a patch of red on basal angles of pronotum and hemelytra. Clothed with very fine, yellowish to dusky, simple pubescence, intermixed with rather sparsely placed tufts of white, deciduous, tomentose pubescence.

FEMALE.—Fig. 133. Length 6.20, width 2.40. Antennae with second segment nearly as thick as first segment but more slender on basal half. Red areas often broader than those of male; usually with basal half of pronotum, embolium, inner half of corium, base and exterior margin of clavus, and cuneus, red; more rarely entirely black, as in male. Pubescence as in male.

FOOD PLANTS. — Hawthorn (*Crataegus* sp.) is the original host, but in many locali-

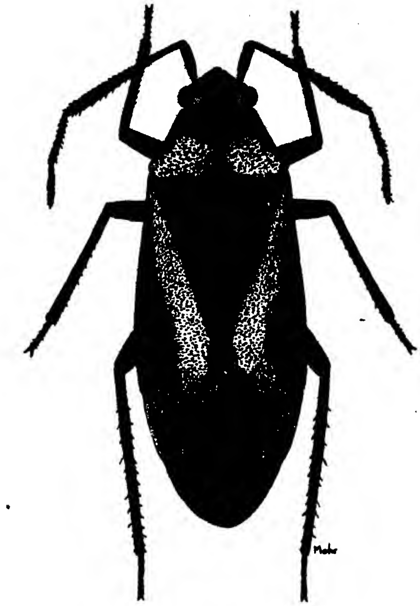


Fig. 133.— *Heterocordylus malinus*, ♀.

ties the species migrates and breeds on cultivated apple (*Pyrus malus*). A single Illinois specimen was collected on locust (*Robinia pseudoacacia*). Known as a pest of apple in New York where the nymphs have been observed to puncture the small fruits; this species is not, however, so serious a pest as *Lygidea mendax* Reuter.

KNOWN DISTRIBUTION. — Illinois, Indiana, Iowa, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New York, Ohio, Ontario, Pennsylvania, Wisconsin.

Illinois Records. — Twenty-one males and 33 females and 7 nymphs, taken May 23 to June 27, are from Eldorado, Elizabeth, Galena, Galesburg, Glen Ellyn, Manito, Pegrim, Willow Springs.

CERATOCAPSINI

KEY TO GENERA

Pronotum anterior to middle nearly cylindrical, rather abruptly flaring behind middle, basal half of disk strongly convex; emboliar margins sulcate on basal half.................. **Pamillia**, p. 108

Pronotum regularly narrowed anteriorly, its sides not constricted at middle; emboliar margins not sulcate, fig. 197.... .... **Ceratocapsus**, p. 108

Pamillia Uhler

No Illinois species; *Pamillia davisi* Knight is known from New Jersey.

Ceratocapsus Reuter

KEY TO SPECIES

1. Clothed only with simple pubescence, although sometimes also with prominent, long, pilose hairs.......... 2
   Clothed with two types of pubescence; bearing either more or less closely appressed, silky, tomentose pubescence, or scalelike pubescence, and in addition intermixed, more erect pubescence...................... 6
2. Head and antennae chiefly red; dorsum uniformly yellowish......... 3
   Head and antennae not distinctly red; dorsum more or less darkened..... 4
3. Antennae entirely red............................ **rubricornis**, p. 109
   Antennae with first segment and basal part of second yellowish.......................... **lutescens**, p. 111
4. Dorsum dark brown, a broad pale or yellowish mark extending across hemelytra just beyond tip of scutellum............. **fasciatus**, p. 109
   Dorsum without transverse pale fascia 5
5. Robust; head and thorax not, or scarcely, darker than hemelytra, which are very dark brown with basal half frequently paler; length 4.30............. **modestus**, p. 111
   Slender; head and thorax black, hemelytra yellowish with a fuscous cloud on corium; sometimes brachypterous; length 4.50............................ **nigrocephalus**, p. 111
6. Dorsum dark brown, a broad, pale mark extending across hemelytra just beyond tip of scutellum; this pale area in cuticula, not formed by pubescence........ **pilosulus**, p. 109
   Dorsum without transverse pale mark 7
7. Pronotum impunctate, sometimes with vague, minute cracks........ 8
   Pronotum punctate, these punctures sometimes rather minute, but always distinctly present.........14
8. Clavus bearing long, pilose hairs.... 9
   Clavus without long, pilose hairs....11
9. Length of first antennal segment equal to not more than three-fourths width of vertex in male, in female less than three-fourths; male slender, length of second antennal segment only slightly exceeding width of head; female brachypterous, disk of corium swollen, convex.................. **camelus**, p. 114
   Length of first antennal segment approximately equal to width of vertex............................10
10. Second antennal segment fuscous at apex; male best distinguished by structure of genital claspers, fig. 134................... **husseyi**, p. 113
    Second antennal segment uniformly pale yellowish; male best distinguished by structure of genital claspers, fig.134...... **sericus**, p. 113
11. Length of third antennal segment not equal to width of vertex plus dorsal width of one eye; color uniformly yellowish, antennae brownish apically............. **luteus**, p. 111
    Length of third antennal segment greater than width of vertex plus dorsal width of one eye..........12
12. Length of second antennal segment approximately equal to or greater than width of pronotum at base; color very dark brown, almost black; length 4.50... **nigellus**, p. 111
    Length of second antennal segment less than width of pronotum at base. . 13
13. Third and fourth antennal segments approximately equal in length; total length 3.10..... **taxodii**, p. 111
    Third antennal segment distinctly longer than fourth; total length 3.40................ **vicinus**, p. 112
14. Length of third antennal segment greater than width of vertex plus dorsal width of one eye..........15
    Length of third antennal segment equal to or less than width of vertex plus dorsal width of one eye......17
15. Length of third antennal segment equal to width of head; female ovate, brachypterous, length 2.50; male length 3.10.... **setosus**, p. 115
    Length of third antennal segment less than width of head..............16
16. Pronotum with a fuscous spot behind each callus; scutellum and clavus bearing a few long, pilose hairs.................. **complicatus**, p. 114

Pronotum with calli and anterior area of disk dark fuscous to black; scutellum and clavus rather thickly clothed with suberect, yellowish pubescence, but without long, pilose hairs............. **pumilus**, p. 112

17. Length of second antennal segment greater than width of head plus dorsal width of one eye.................................. **incisus**, p. 113

    Length of second antennal segment not exceeding width of head plus dorsal width of one eye..........18

18. Membrane uniformly pale, darkest specimens with membrane slightly smoky; length 2.80.......................... **quadrispiculus**, p. 114

    Membrane dark...................19

19. Second and third antennal segments uniformly pale yellowish.......................... **uniformis**, p. 113

    Third antennal segment dark or reddish brown.....................20

20. Dorsum densely clothed with erect, rather bristly pubescence.......................... **digitulus**, p. 115

    Dorsum more sparsely clothed with semierect pubescence.............21

21. Membrane uniformly fuscous........................ **decurvatus**, p. 116

    Membrane pale, fuscous on apical one-third only....... **fuscinus**, p. 115

Ceratocapsus fasciatus (Uhler)

Megacoelum fasciatum Uhler (1877, p. 421).

MALE.—Length 3.00, width 1.30. Head width 0.65, vertex 0.28. Antennae, first segment, length 0.26; second, 0.91; third, 0.60; fourth, 0.48. Pronotum, length 0.56, width at base 1.04. General color dark chestnut brown with legs and antennae paler; hemelytra with a broad, transverse, pale yellowish band behind tip of scutellum; clothed only with fine recumbent, yellowish pubescence. Genital claspers as in fig. 134.

FEMALE.—Length 3.10, width 1.40. Head width 0.67, vertex 0.33. Antennae, first segment, length 0.29; second, 0.99; third, 0.61; fourth, 0.52. Pronotum, length 0.56, width at base 0.67. Very similar to male in color and pubescence.

HOST PLANT.—Hickory (*Carya* sp.).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New York, North Carolina, Ohio, Virginia.

Illinois Records.—ILLINOIS: July 16, 1892, 1 ♂; 1 ♂, 2 ♀. ARGO: Aug. 13, 1916, W. J. Gerhard, 1 ♂, FM. DUBOIS: July 2, 1909, beating from tree, 1 ♀. GALESBURG: June 27, 1892, 2 ♀. PALOS PARK: July 27, 1913, on hickory, W. J. Gerhard, 1 ♀, FM.

Ceratocapsus rubricornis Knight

Ceratocapsus rubricornis Knight (1927*c*, p. 145).

MALE.—Length 4.30, width 1.70. Antennae deep red, last two segments somewhat darker red. Clothed with simple, yellowish pubescence; a few longer, more nearly erect hairs on base of clavus, scutellum and disk of pronotum. Color uniformly pale yellowish; antennae, head, propleura above middle of coxal cleft, and hind tibiae, bright red. Genital claspers distinctive, fig. 134; differ from those of *lutescens* Reuter by long, decurved, sickle-shaped apical half of right clasper and by broader basal spine.

FEMALE.—Length 4.40, width 1.90. In coloration and pubescence similar to male.

FOOD PLANTS.—Collected on linden (*Tilia americana*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Mississippi.

Illinois Record.—GALESBURG: August, on linden, 1 ♀.

Ceratocapsus pilosulus Knight

Ceratocapsus pilosus Knight (1923*d*, p. 526). *Preoccupied.*

Ceratocapsus pilosulus Knight (1930*c*, p. 198).

This species is very similar to *fasciatus* (Uhler) in size and coloration but is readily to be distinguished by the long, pilose hairs on the head and the dorsum, and by the claspers, fig. 134.

MALE.—Length 3.40, width 1.30. Front beset with several prominent, erect hairs. Rostrum attaining hind margins of posterior coxae. Antennae with second segment becoming gradually thicker from base to apex, yellowish brown; third brownish; fourth dark brown. Pronotum clothed with fine, yellowish pubescence, margins of disk beset with prominent pilose hairs. General color dark brown; hemelytra with a broad, transverse, pale yellowish fascia just behind apex of scutellum. Hemelytra clothed with very

fine, closely appressed, sericeous pubescence, intermixed with longer recumbent pubescence and sparsely set, erect, pilose hairs, pubescence taking color of surface beneath.

FEMALE.—Length 3.60, width 1.60. More robust than male, but very similar in color and pubescence.

FOOD PLANTS.—Collected on hop hornbeam (*Ostrya virginiana*), bur oak (*Quercus macrocarpa*) and hazelnut (*Corylus americana*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Massachusetts, Minnesota, New York.

Illinois Records.—NORTHERN ILLINOIS: July, 1 ♀; 1 ♂, 1 ♀. ALGONQUIN: June 10, 1896, 2 ♂, 1 ♀. GALENA: June 30, 1932,

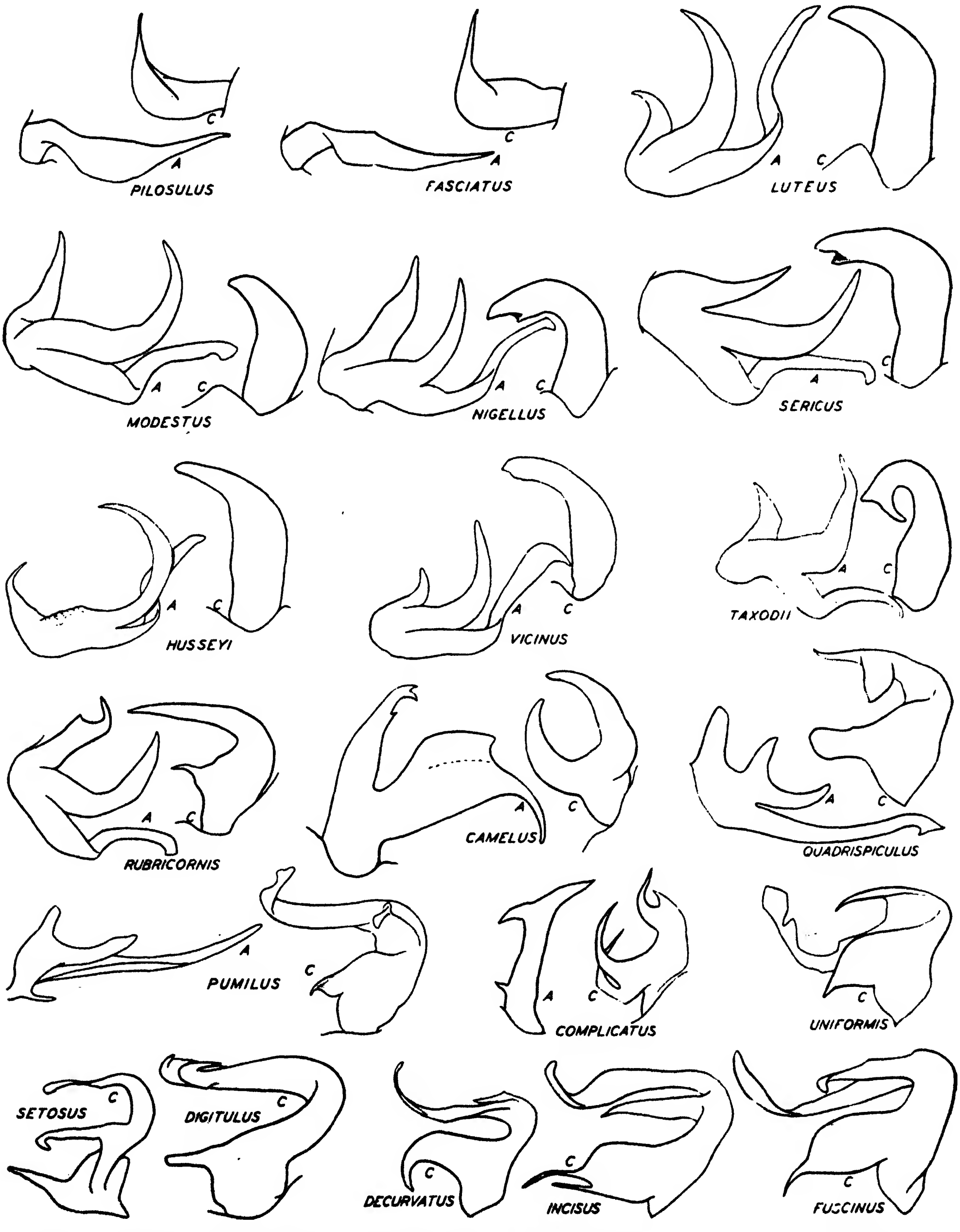


Fig. 134.—Male genital claspers of *Ceratocapsus*. *A*, left clasper, lateral aspect; *C*, right clasper, lateral aspect.

Dozier & Mohr, on *Corylus* sp., 9 ♂, 5 ♀. WILLOW SPRINGS: June 28, 1903, W. J. Gerhard, 1 ♂, 2 ♀, FM; June 26, 1904, W. J. Gerhard, 1 ♂, FM; July 8, 1906, W. J. Gerhard, 1 ♀, FM; July 18, 1909, A. B. Wolcott, 1 ♂, FM.

Ceratocapsus lutescens Reuter

Ceratocapsus lutescens Reuter (1876, p. 87).

Not taken in Illinois; known from Florida, Kansas, Long Island, New York, Texas.

Ceratocapsus nigrocephalus Knight

Ceratocapsus nigrocephalus Knight (1923*d*, p. 534).

Not taken in Illinois; known from Iowa, Michigan, Minnesota, New Hampshire, Ontario, Quebec, South Dakota.

Ceratocapsus modestus (Uhler)

Melinna modesta Uhler (1887*c*, p. 69).

MALE.—Length 4.00, width 1.40. General color yellowish brown to dark fuscous brown. Dorsum impunctate, surface very finely alutaceous; scutellum, clavus and inner apical margin of corium beset with a few long erect hairs, but devoid of closely appressed, sericeous pubescence. Genital claspers as in fig. 134.

FEMALE.—Length 4.40, width 1.70. Similar to male in general color.

FOOD PLANTS. — Occurs on basswood (*Tilia americana*), oak (*Quercus* sp.), alder (*Alnus rugosa*) and grape (*Vitis* sp.).

KNOWN DISTRIBUTION.—Extensive over the eastern United States.

Illinois Records.—Thirty males and 22 females, taken June 24 to Sept. 4, are from Algonquin, Antioch, Argo, Cary, Chicago, De Soto, Eichorn, Fox Lake, Galesburg, Glen Ellyn, Havana, Pulaski, Starved Rock State Park, Urbana, Waukegan, West Pullman, Willow Springs.

Ceratocapsus nigellus Knight

Ceratocapsus nigellus Knight (1923*d*, p. 528).

This resembles the dark forms of *modestus* (Uhler), but is readily distinguished by the pubescence of the scutellum.

MALE.—Length 4.50, width 1.70. Antennae clothed with short, closely set pubescence; dark reddish brown to blackish. Pronotum alutaceous, finely and sparsely pubescent, a few, more nearly erect hairs also present. Scutellum, clavus and basal half of corium clothed with closely appressed, scalelike pubescence sparsely intermixed with simple pubescence. General color very dark brown, almost black; cuneus frequently more reddish brown; tibiae yellowish brown. Membrane and veins uniformly fuscous, area bordering apex of cuneus slightly paler. Genital claspers as in fig. 134.

FEMALE.—Length 4.60, width 1.84. Very similar to male in color and pubescence.

HABITS.—Collected on hickory (*Carya* sp.), the nymphs frequently found on the trunk and larger limbs of the trees; perhaps predacious.

KNOWN DISTRIBUTION. — Georgia, Illinois, Iowa, Maryland, Minnesota, New Jersey, New York, North Carolina, Ohio, Virginia.

Illinois Records.—Nineteen males and 22 females, taken June 11 to Aug. 9, are from Galena, Galesburg, La Rue, Monticello, Oakwood, Round Lake, Shawneetown, Urbana, Waukegan, White Pines Forest State Park, Zion.

Ceratocapsus luteus Knight

Ceratocapsus luteus Knight (1923*d*, p. 527).

MALE.—Length 3.80, width 1.46. Antennae with first segment yellowish, second yellowish, brownish on apical half, third fusco-brownish, fourth very dark brown. Pronotum impunctate, somewhat alutaceous. Dorsum clothed with very fine, simple, yellowish pubescence, intermixed with closely appressed, silvery, scalelike pubescence on scutellum, clavus and inner half of corium. General color uniformly yellowish, tinged with brownish; membrane uniformly pale fumate, veins tinged with yellowish. Claspers as in fig. 134.

FEMALE.—Length 4.00, width 1.64. Very similar to male in color and pubescence.

KNOWN DISTRIBUTION. — Illinois, New York, West Virginia.

Illinois Record.—BEACH: Aug. 7, 1935, DeLong & Ross, 1 ♂, 1 ♀.

Ceratocapsus taxodii Knight

Ceratocapsus taxodii Knight (1927*c*, p. 143).

This species is allied to *luteus* Knight but is distinguished by its smaller size, longer second antennal segment, and yellow antennae with a reddish fourth segment.

MALE.—Length 3.20, width 1.30. Antennae with all segments nearly equal in thickness; all but fourth yellow; the fourth segment reddish. Pronotum impunctate, alutaceous. Dorsum clothed with fine, simple, yellowish pubescence, intermixed on scutellum, clavus and inner half of corium with closely appressed, silvery, scalelike pubescence. General color light reddish; hemelytra more or less translucent, old specimens may become brownish red; membrane pale fuscous, becoming gradually paler toward base. Genital claspers distinctive, fig. 134.

FEMALE.—Length 3.10, width 1.30. Very similar to male in pubescence and coloration.

FOOD PLANT.—Cypress (*Taxodium distichum*).

KNOWN DISTRIBUTION. — Florida, Illinois, Louisiana, Mississippi, Tennessee.

Illinois Records.—CAIRO: July 27, 1930, on *Taxodium distichum*, Knight & Ross, 4 ♂, 2 ♀. ELIZABETHTOWN: July 25, 1930, on *Taxodium distichum*, Knight & Ross, 1 ♂, 8 ♀. HORSESHOE LAKE: July 11, 1935, DeLong & Ross, 11 ♂, 22 ♀. JONESBORO: Aug. 2, 1932, on *Taxodium distichum*, H. L. Dozier, 2 ♂, 6 ♀. KARNAK: July 26, 1930, on *Taxodium distichum*, Knight & Ross, 4 ♂, 13 ♀; June 23, 1932, Ross, Dozier & Park, 1 ♂.

Ceratocapsus pumilus (Uhler)

Melinna pumila Uhler (1887*c*, p. 69).

MALE.—Length 3.70, width 1.50. Antennae with first segment yellowish, a red mark present near base; second yellowish, third yellowish, apical half reddish brown; fourth brownish. Dorsum with fine, black punctures; thickly clothed with prominent, simple, yellowish pubescence intermixed with shorter, closely appressed, silvery yellow, sericeous pubescence. General color yellowish brown to dark brown, calli and anterior third of pronotum almost black; dark specimens with the whole dorsum very dark brown, almost black; membrane fuscous, paler on basal half. Genital claspers distinctive, fig. 134.

FEMALE.—Fig. 135. Length 3.90, width 1.70. More robust than male, but very similar in color, pubescence and punctuation.

FOOD PLANTS.—Occurs most frequently on grape (*Vitis* sp.) and willow (*Salix* sp.); also taken on red birch (*Betula nigra*).

KNOWN DISTRIBUTION.—Extensive over the eastern United States and Canada.

Illinois Records. — One hundred one males and 81 females, taken June 10 to Sept. 20, are from Algonquin, Alton, Antioch, Apple River Canyon State Park, Beardstown, Browns, Carbondale, Des Plaines, Dolson, Eichorn, Elizabethtown, Galesburg, Golconda, Hardin, Harrisburg, Herod, Homer Park, Kampsville, Kankakee, Kansas, Metropolis, Monticello, Muncie, Pike, Putnam, Savanna, Seymour, Starved Rock State Park, Topeka, Vienna, Walnut Prairie, West Union, White Heath, York.

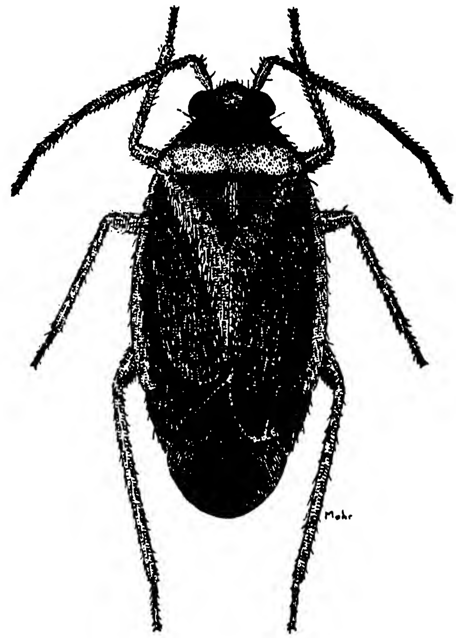


Fig. 135.—*Ceratocapsus pumilus*, ♀.

Ceratocapsus vicinus Knight

Ceratocapsus vicinus Knight (1923*d*, p. 529)

MALE.—Length 3.40, width 1.40. Antennae with first segment yellowish, frequently a red mark on ventral surface; second yellowish, brownish at apex; third reddish brown; fourth reddish brown. Pronotum impunctate, alutaceous, sparsely clothed with fine, yellowish pubescence. Scutellum, clavus and basal half of corium covered with closely appressed, silvery, scalelike pubescence. General color fulvous to reddish; scutellum and apical half of hemelytra dark brownish to blackish; legs yellowish; membrane pale, apical half fus-

cous. Genital claspers distinctive, fig. 134.

FEMALE.—Length 3.60, width 1.60. More robust than male, but very similar in color and pubescence.

KNOWN DISTRIBUTION. — Illinois, New Jersey, New York.

Illinois Records. — ASHLEY: Aug. 7, 1917, 1 ♀. MEREDOSIA: Aug. 22, 1917, sand pit, 1 ♀.

Ceratocapsus sericus Knight

Ceratocapsus sericus Knight (1923*d*, p. 530).

MALE.—Length 3.90, width 1.56. Dorsum clothed with rather sparsely set, erect, yellowish, pilose hairs; scutellum, clavus and inner half of corium covered with closely appressed, sericeous or scalelike pubescence. General color very dark brown; legs and antennae yellowish; third and fourth antennal segments dark reddish brown. Membrane and veins uniformly pale fuscous, a small clear spot bordering apex of cuneus. Genital claspers distinctive, fig. 134.

FEMALE.—Length 4.10, width 1.66. Very similar to male in color and pubescence.

KNOWN DISTRIBUTION.—Illinois, Michigan, New Jersey, New York, Pennsylvania, Wisconsin.

Illinois Records. — GALESBURG: 1 ♂; July 16, 1892, 1 ♀.

Ceratocapsus incisus Knight

Ceratocapsus incisus Knight (1923*d*, p. 532).

MALE.—Length 3.70, width 1.50. Antennae with second segment slender at base and gradually thickened toward apex; third brownish, nearly equal in thickness to second segment; fourth brownish, equal in thickness to third segment. Disk with fine, black punctures similar to those on clavus and corium. Dorsum clothed with prominent, suberect, yellowish pubescence, intermixed on scutellum, clavus and corium with closely appressed, silvery, sericeous or scalelike pubescence. General color very dark brown, more yellowish on clavus, embolium and base of pronotum; membrane and veins pale fumate, apical half fuscous, margins slightly paler. Legs yellowish to greenish; femora scarcely darker. Genital claspers distinctive, fig. 134.

FEMALE.—Length 4.00, width 1.70. Antennae with second segment slender, slightly thicker apically, yellowish; third brownish, paler at base; fourth brownish. Very similar to male in pubescence and coloration.

FOOD PLANTS.—Occurs on willow (*Salix* sp.), alder (*Alnus rugosa*) and hornbeam (*Carpinus caroliniana*).

KNOWN DISTRIBUTION. — Illinois, Iowa, New York, Ohio.

Illinois Records.—NORTHERN ILLINOIS: 1 ♀. EICHORN: June 24, 1932, Hicks Branch, on *Alnus rugosa*, Ross, Dozier & Park, 1 ♀. ELIZABETHTOWN: June 22-24, 1932, Ross, Dozier & Park, 2 ♂, 2 ♀. HARRISBURG: June 25, 1932, on *Carpinus caroliniana*, Ross, Dozier & Park, 6 ♂, 7 ♀. KARNAK: June 14, 1934, DeLong & Ross, 4 ♂.

Ceratocapsus husseyi Knight

Ceratocapsus husseyi Knight (1930*c*, p. 196).

MALE.—Length 4.00, width 1.57. Antennae with second segment yellowish, fuscous on apical one-third; third fuscous with a narrow yellowish area at base; fourth fuscous. Pronotum impunctate, alutaceous. Dorsum clothed with two types of pubescence; sparsely set with rather long, erect hairs; and scutellum, clavus and corium also bearing closely appressed, silvery, scalelike hairs. General color very dark brown; inner half of clavus, narrow area at base of corium, entire embolium, and base of pronotum, yellowish. Membrane uniformly fuscous, paler within areoles and on areas bordering cuneus. Genital claspers distinctive, fig. 134, differing from *sericus* Knight particularly in left clasper.

FEMALE.—Length 4.40, width 1.60. Very similar to male in color and pubescence.

KNOWN DISTRIBUTION. — Illinois and Michigan.

Illinois Record.—GALESBURG: July 16, 1892, Stromberg, 2 ♀.

Ceratocapsus uniformis Knight

Ceratocapsus uniformis Knight (1927*c*, p. 147).

The dorsum of this species is more sparsely covered with yellowish, simple pubescence than in *pumilus* (Uhler), and the pubescence in *uniformis* is intermixed with silvery, sericeous hairs; the punctation in *uniformis* is stronger and more distinct than in *pumilus*.

MALE.—Length 3.00, width 1.50. Rostrum reaching middle of hind coxae. Antennae yellowish, with fourth segment brownish. General color uniformly dark reddish

brown; darker at anterior half of pronotum and somewhat paler at basal margin. Membrane and veins uniformly fuscous, a pale spot present near apex of cuneus. Genital claspers distinctive, fig. 134.

FEMALE.—Length 3.00, width 1.50. Similar to male in punctation, pubescence and coloration.

FOOD PLANT.—Collected on walnut (*Juglans nigra*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Maryland, Mississippi, Missouri, Ohio, Virginia, West Virginia.

Illinois Records. — DE SOTO: July 28, 1930, Knight & Ross, 1 ♂. GRAFTON: July 20, 1932, on *Juglans nigra*, Ross & Dozier, 2 ♂, 2 ♀. METROPOLIS: July 26, 1930, Knight & Ross, 1 ♀.

Ceratocapsus camelus Knight

Ceratocapsus camelus Knight (1930*c*, p. 187).

MALE.—Length 3.80, width 1.08. Form slender. Head width 0.73; vertex 0.38, convexly rounded, basal edge thin, slightly overlapping collar. Pronotum, length 0.82, width at base 1.08; nearly campanulate in form, lateral margins sulcate, coxal clefts visible from above; disk strongly convex, smooth, shining; calli scarcely evident. General color dark brown to almost black; pronotal disk and cuneus darker and shining; ostiolar peritreme white, somewhat protruding laterally. Hemelytra dark brown, translucent, strongly shining, emboliar margins sinuate; a silvery, sericeous, pubescent band extending across middle of corium and clavus near apex; also with similar pubescence at base of clavus and across middle of scutellum; scutellum, clavus and inner angle of corium beset with several erect, moderately long, yellowish, bristlelike hairs; cuneus scarcely deflexed, uniformly very dark brown. Membrane uniformly dark fuscous, area bordering cuneus, and spaces between and within larger areoles, pale. Genital structures distinctive, right clasper bifurcate, each half curving in a semicircle, tips nearly in contact, fig. 134.

FEMALE. — Length 2.80; brachypterous, width across abdomen 1.12. Head width 0.80, vertex 0.52; large, eyes rather small, frons, vertex and tylus forming an arcuate line as viewed from side. Antennae, first segment, length 0.22, pale brownish; second, 1.77, becoming progressively larger from base to apex, very dark brown. Pronotum, length 0.65, width at base 0.67; disk strongly convex, base strongly depressed below level of anterior margin, sides rounded and slightly sinuate, coxal clefts visible from above. Scutellum depressed, small, triangular, mesoscutum visible, sharply declivent. Hemelytra abbreviated, reaching to middle of abdomen, depressed at base, corium tumidly convex on apical area, shining, apical and inner margins thickly clothed with silvery, sericeous pubescence and also beset with several erect, fine, long hairs; cuneus and membrane absent. Basal abdominal sternite with a frosted spot just posterior to each hind coxa.

KNOWN DISTRIBUTION.—Illinois.

Illinois Records.—ALGONQUIN: July 17, 1896, 1 specimen. URBANA: Aug. 21, 1926, Vera Smith, 1 ♂, 1 ♀.

Ceratocapsus complicatus Knight

Ceratocapsus complicatus Knight (1927*c*, p. 148).

MALE.—Length 3.80, width 1.50. Antennae with first segment yellowish, a red mark near base; second yellowish; third reddish brown; fourth dark reddish. General color and punctation nearly as in *pumilus* (Uhler), but dorsum is clothed with silvery, sericeous pubescence sparsely intermixed with long, erect, pilose hairs and usually has two fuscous spots visible on the pronotal disk, one behind each callus. Craspers as in fig. 134.

FEMALE.—Length 3.10, width 1.40. Very similar to male in pubescence, puncturation and coloration.

KNOWN DISTRIBUTION.—Florida, Illinois, Maryland, Mississippi, Missouri, Texas, Virginia.

Illinois Records. — HARRISBURG: June 15, 1934, DeLong & Ross, 1 ♀. HAVANA: Aug. 30, 1917, 1 ♂. HEROD: Aug. 4, 1934, DeLong & Ross, 1 ♂. QUINCY: Aug. 11, 1889, C. A. Hart, 2 ♂.

Ceratocapsus quadrispiculus Knight

Ceratocapsus quadrispiculus Knight (1927*c*, p. 148).

This species is allied to *uniformis* Knight, and is very similar to it in size and coloration, but differs in having strongly arcuate emboliar margins, a somewhat shorter rostrum and a uniformly pale, smoky membrane; the genital claspers are distinctive, fig. 134.

MALE.—Length 2.90, width 1.50. Antennae yellowish; first segment with red mark near base; fourth segment reddish. Dorsum with irregular, fine, black punctations; clothed with prominent, erect, pale hairs intermixed with appressed, silvery, sericeous pubescence that appears to arise from punctures on hemelytra and scutellum. General color dark reddish brown, more blackish on scutellum and on anterior portion of pronotum; punctures black; legs uniformly yellowish; membrane and veins uniformly pale dusky.

FEMALE.—Length 3.20, width 1.50. More robust than male, but very similar in pubescence and coloration.

FOOD PLANT. — Collected on hornbeam (*Carpinus caroliniana*).

KNOWN DISTRIBUTION.—Illinois, Louisiana, Texas.

Illinois Records. — DONGOLA: July 2, 1916, 1 ♂. HEROD: July 24, 1930, on *Carpinus* sp., Knight & Ross, 2 ♂, 3 ♀.

Ceratocapsus digitulus Knight

Ceratocapsus digitulus Knight (1923*d*, p. 533).

MALE.—Length 3.40, width 1.60. Antennae with first segment yellowish; second yellowish, thickened on apical half, but not attaining thickness of first segment; third scarcely equal in thickness to second segment, yellowish, apical half brownish; fourth brownish. Pronotum punctate, dark brownish, almost black on calli. Dorsum rather densely clothed with erect, somewhat bristly pubescence, intermixed on scutellum and hemelytra with closely appressed, silvery, scalelike pubescence. General color dark brown with a reddish tinge; cuneus reddish brown, embolium translucent yellowish; legs greenish or yellowish; membrane uniformly fusco-brownish, scarcely paler on areas bordering cuneus. Genital claspers distinctive, fig. 134.

FEMALE.—Length 3.50, width 1.70. Antennae with second segment slender, gradually thickened apically; third nearly equal in thickness to that of apex of second segment, yellowish to brownish; fourth brownish. Hemelytra more arcuate than in male, but pubescence, punctation and coloration very similar.

KNOWN DISTRIBUTION.—Illinois, Maryland, Massachusetts, New York, North Carolina, Ontario, Virginia.

Illinois Records.—DUBOIS: July 2, 1909, beating from trees, 1 ♀. VIENNA: June 14, 1934, DeLong & Ross, 2 ♂.

Ceratocapsus setosus Reuter

Ceratocapsus setosus Reuter (1909, p. 70).

MALE.—Length 2.80, width 1.10. Antennae with first segment yellowish, a red mark near base; second yellowish; third fuscous, paler at base; fourth fuscous. Pronotum with disk finely punctate. Dorsum clothed with sparsely set, erect, pilose hairs, intermixed on hemelytra and scutellum with closely appressed, silvery, sericeous pubescence. General color dark brownish, shining; head paler; legs yellowish. Genital claspers distinctive, fig. 134.

FEMALE.—Length 2.60, width 1.43; brachypterous, ovate. Hemelytra rounded at apex, membrane absent or only a mere trace of it remaining at anal angle. Color, punctuation and pubescence similar to those of male. Macropterous females occur in southern states, but appear rarer farther north.

FOOD PLANTS. — Occurs frequently on ferns.

KNOWN DISTRIBUTION.—District of Columbia, Georgia, Illinois, Indiana, Kentucky, Maryland, Mississippi, New Jersey, Ohio, Pennsylvania, Virginia.

Illinois Records.—Eleven males and two females, taken May 19 to Aug. 23, are from Anna, Bluff Springs, Danville, Dongola, Elizabeth, Hardin, Herod, Muncie, Rockton, Union County State Forest, Urbana.

Ceratocapsus fuscinus Knight

Ceratocapsus fuscinus Knight (1923*d*, p. 531).

MALE.—Length 3.70, width 1.61. Antennae with first segment yellow, a red spot on inner side at base; second slender at base and becoming gradually thicker apically, attaining thickness of first segment, yellowish; third yellowish, becoming fuscous on apical half; fourth equal in thickness to third segment, fusco-brownish. Dorsum punctate, clothed with suberect, yellowish pubescence, this pubescence longer and more prominent than in *pumilus* (Uhler) and intermixed with closely appressed, silvery, sericeous pubescence. General color yellowish brown to very dark brown, almost black; calli and anterior portion of pronotum usually blackish; hemelytra yellowish brown, often infuscated; cuneus reddish. Legs yellowish;

femora reddish on apical half; membrane pale fumate, a distinct fuscous cloud occupying middle of apical half. Genital claspers distinctive, fig. 134, both right and left claspers composed of three prongs each.

FEMALE.—Length 3.60, width 1.60. Very similar to male in pubescence and punctation, but emboliar margins more strongly arcuate; pronotum yellowish, only calli and a ray across top of coxal cleft blackish; venter reddish to brownish.

HABITS.—Occurs on willows (*Salix nigra* and *S. amygdaloides*). Evidently predacious in habits.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Iowa, Louisiana, Maryland, Minnesota, Mississippi, Missouri, New York, Ohio.

Illinois Records.—Forty males, 49 females and 1 nymph, taken May 25 to Aug. 30, are from Algonquin, Alton, Antioch, Eichorn, Galesburg, Golconda, Grand Detour, Grand Tower, Havana, Homer Park, Kampsville, Lawrenceville, Meredosia, Metropolis, Monticello, Muncie, Paxton, Putnam, Quincy, St. Joseph, Savanna, Topeka, Urbana, West Union.

Ceratocapsus decurvatus Knight

Ceratocapsus decurvatus Knight (1930*c*, p. 194).

MALE.—Length 3.70, width 1.64. Antennae pale yellowish, segments three and four reddish. Dorsum punctate, clothed with prominent, nearly erect, yellowish pubescence intermixed on scutellum and hemelytra with silvery, sericeous pubescence; more strongly pubescent than *pumilus* (Uhler), although fuscous punctures on dorsum are very similar. General color yellowish to brownish, calli and propleura dark brown; cuneus reddish, except on outer margin; legs uniformly yellowish; membrane uniformly fuscous. Genital claspers distinctive for species, fig. 134.

FEMALE.—Length 3.80, width 0.88. Very similar to male in pubescence, punctation and coloration.

HABITS.—Predacious; collected on alder (*Alnus rugosa*).

KNOWN DISTRIBUTION.—Illinois, Maryland, New York, Pennsylvania.

Illinois Records.—EICHORN: June 24, 1932, on *Alnus rugosa*, Ross, Dozier & Park, 3 ♂, 1 ♀; June 13, 1934, DeLong & Ross, 6 ♂, 1 ♀.

SYSTELLONOTINI

KEY TO GENERA

Scutellum conically produced, fig. 137; hemelytra with a transverse white fascia across middle of clavus and base of corium...... **Cyrtopeltocoris**, p. 117

Scutellum only moderately convex, fig. 136; hemelytra with a pale spot on clavus, or white spot at base of corium, but, in either case, these white marks not forming a complete transverse fascia... .... **Sericophanes**, p. 116

Sericophanes Reuter

Sericophanes heidemanni Poppius

Sericophanes ocellatus Osborn (1898, p. 238) *not* Reuter.

Sericophanes heidemanni Poppius (1914*b*, p. 260).

Sericophanes noctuans Knight (1917*a*, p. 4).

MALE.—Length 3.40, width 1.00. General color dark chestnut to black. Legs yellowish brown; tibiae darker, posterior coxae pale; antennae yellowish brown, darker on third and fourth segments, fourth segment slightly compressed. Hemelytra velvety brown, darker at base of clavus; two transverse, irregular, silvery bars over brown; a cream-colored round spot on clavus just beyond scutellum; membrane light smoky, pale areas bordering apical third of cuneus.

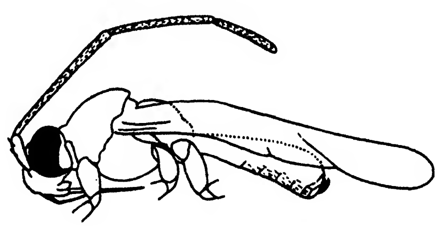


Fig. 136.—*Sericophanes heidemanni.*

FEMALE.—Brachypterous. Length 3.10, width of abdomen 0.97. Antlike in form. General color yellowish brown. Prothorax subglobose; hemelytra much reduced, reaching only base of third abdominal tergite; cream-colored spot present just beyond scutellum; abdomen subglobose, pleural margins prominent, fourth to seventh segments dark brownish to piceous; sternites paler on areas bordering ovipositor.

HABITS.—This species, fig. 136, has been found to occur on grassy ridges. Males are

frequently collected at light. In New York, Dr. C. P. Alexander in letter reports this species as flying up in large numbers from the grass after sundown. In Iowa I found this species abundant in closely cropped pasture land where the little brown ants *Lasius alienus* var. *americanus* Emery were abundant.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Montana, New York, North Carolina, Ohio, Ontario, Pennsylvania, South Dakota, Utah, Washington, Wyoming.

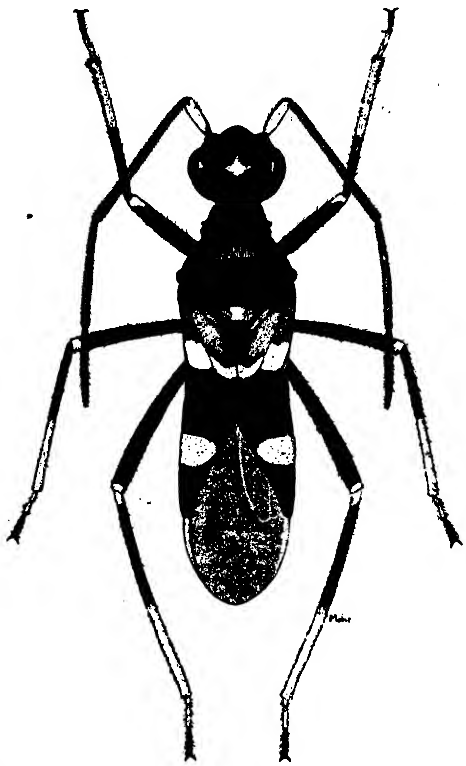
Illinois Records.—Seventeen males, taken May 10 to Aug. 22, are from Algonquin, Chicago, Oak Lawn, Palos Park, Urbana, Willow Springs.

Cyrtopeltocoris Reuter

Cyrtopeltocoris illini new species

This species is to be distinguished from allied species by the pointed, conical development of the scutellum, fig. 137.

MALE.—Fig. 137. Length 3.60, width 0.91. Head width 0.75, vertex 0.52; eyes scarcely raised above contour of frons, a sharp carina at base of vertex. Rostrum, length 1.40, reaching to middle of hind coxae. Antennae, first segment, length 0.28, pale to white; second, 1.25, nearly cylindrical, fuscous brown, with fine, pale pubescence; third, 0.86, equal in thickness to second segment, dark brown; fourth, 0.60, thickness equal to that of preceding segments, dark brown. Pronotum, length 0.73, width at base 0.95, disk strongly convex on basal half, collar distinctly narrowed, not equal to width of vertex. Scutellum remarkably developed into a vertical cone with an acuminate point, mesoscutum broadly exposed and sloping downward to base of scutellum. General color medium brown to dark brown, smooth or only very minutely punctate, mod-



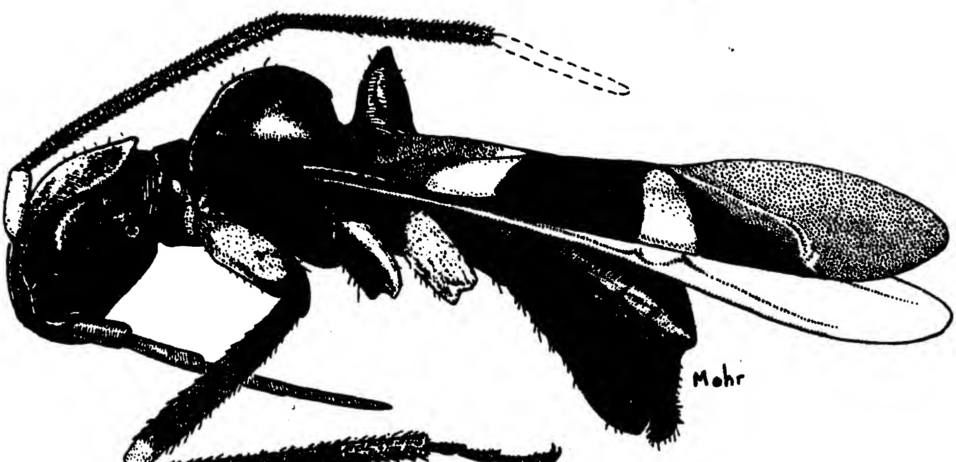


Fig. 137.—*Cyrtopeltocoris illini*, dorsal and lateral aspects.

erately shining; with sparse and very fine, pale pubescence. Hemelytra slightly constricted near middle, dark brown, strongly shining; clavus paler brown on basal half, crossed on apical half by a clear white band that becomes wider on corium and reaches costal margin; a white spot present on cori-

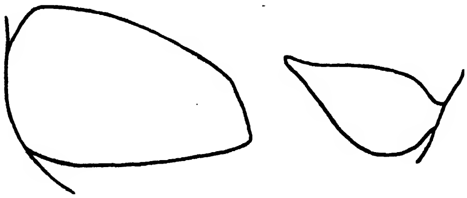


Fig. 138.—*Cyrtopeltocoris illini*, male claspers.

um bordering base of cuneus; membrane uniformly fuscous, slightly paler at tip of cuneus. Legs mostly medium brown to dark brown; coxae white, middle pair reddish brown at base; apex of hind femora and base of tibiae pale; tibiae paler on apical one-third. Genital segment distinctive, fig. 138.

Holotype, male — Dolson, Ill., Rocky Branch: June 25, 1932, Frison & Mohr.

Paratypes.—ILLINOIS.—GEFF: June 12, 1934, DeLong & Ross, 1 ♂. MORTON: July 22, 1928, A. R. Park, 1 ♂. URBANA: July 10, 1940, in building, C. O. Mohr, 1 ♂.

MISSOURI.—ST. LOUIS: June 25, 1939, R. C. Froeschner, 1 ♂.

PILOPHORINI

KEY TO GENERA

1. Vertex not compressed posteriorly, fig. 139; length of first antennal segment nearly equaling width of head; anterior half of pronotum constricted, its sides at that point nearly parallel .... **Pseudoxenetus,** p. 118
   Vertex compressed posteriorly, slightly overlapping anterior edge of pronotum, fig. 140; length of first antennal segment not exceeding width of vertex 2
2. Second antennal segment scarcely thickened toward apex; width of head across eyes equal to or greater than posterior width of pronotum, fig. 140; hemelytra with emboliar margins parallel.... **Alepidia,** p. 119
   Second antennal segment thickened toward apex; width of head less than width of posterior margin of pronotum, fig. 141 3
3. Lateral margins of hemelytra slightly constricted and recurved ventrad, bearing white pubescent bands, fig. 141 .... **Pilophorus,** p. 119
   Lateral margins of hemelytra slightly arcuate, bearing silvery pubescence, but this pubescence not forming distinct bands...... **Alepidiella,** p. 119

Pseudoxenetus Reuter

KEY TO SPECIES

Entire pronotum and prosternum dark brown or black...... **scutellatus,** p. 118
Disk of pronotum and prosternum orange or reddish........ **regalis,** p. 119

Pseudoxenetus scutellatus (Uhler)

Xenetus scutellatus Uhler (1890, p. 81).

ADULTS.—Fig. 139. Length 6.50, width 1.20. Black; scutellum yellow, except for

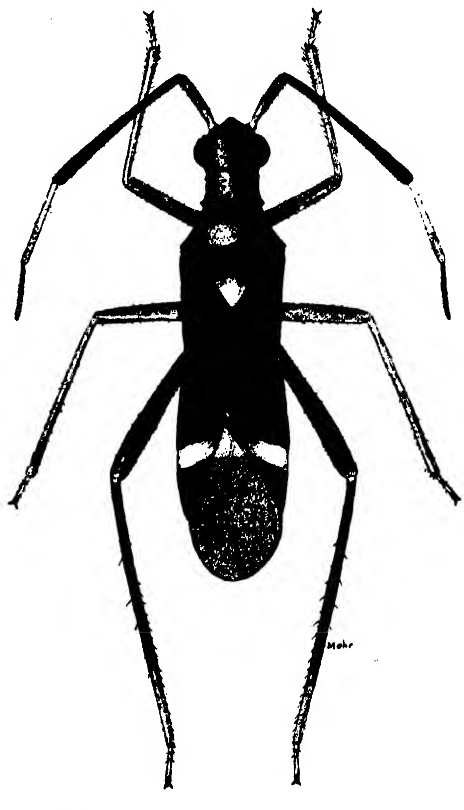


Fig. 139.—*Pseudoxenetus scutellatus.*

narrow area at base; cuneus with white translucent band at base; posterior coxae pale, legs mostly dark brownish, anterior and middle tibiae yellowish.

FOOD PLANTS.—Oaks (*Quercus muhlenbergii, Q. rubra* and *Q. alba*); occasionally ash (*Fraxinus* sp.). A single specimen was taken on apple in Illinois.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Maryland, Massachusetts, Minnesota, New York, North Carolina, Ohio, Ontario, Pennsylvania, Virginia.

Illinois Records.—Thirty-nine males and 38 females, taken May 9 to July 8, are from Antioch, Bluff Springs, Champaign, Dongola, Dubois, Elizabeth, Fox Lake, Galesburg, Glen Ellyn, Grand Detour, Havana, Keithsburg, Meredosia, Muncie, Oregon, St. Anne, Summerfield, Urbana, Willow Springs.

Pseudoxenetus regalis (Uhler)

Xenetus regalis Uhler (1890, p. 80).

ADULTS.—Length 6.50, width 2.00. General color black; very similar to *scutellatus* (Uhler), but with basal half of pronotum, sternum and pleura largely red.

FOOD PLANTS.—Usually live oak (*Quercus virginiana*); collected also on other oaks (*Q. alba, Q. rubra* and *Q. marilandica*) in Illinois.

KNOWN DISTRIBUTION.—Florida, Georgia, Illinois, Maryland, Mississippi, North Carolina, Oklahoma.

Illinois Records.—Ten males and 11 females, taken May 15 to June 15, are from Dubois, Galesburg, Havana, Keithsburg, Meredosia, St. Anne.

Alepidia Reuter

Alepidia gracilis (Uhler)

Pilophorus gracilis Uhler (1895, p. 42).

ADULTS.—Fig. 140. Length 4.20, width 1.30. General color black, slightly shining; hemelytra ferruginous black, membrane pale fuscous; a darker spot on either side covering apex of brachium; pale area present bordering cuneus; antennae and legs pale yellowish; femora sometimes darkened; abdomen with a patch of silvery scales on either side near base.

HOST PLANTS.—Red pine (*Pinus resinosa*), Scotch pine (*P. sylvestris*) and Austrian pine (*P. nigra* var. *austriaca*).

A single female of this spceies from Galena shows a greater development of spots of silver pubescence on the hemelytra and is referable to the variety *squamosa* Knight (1926*d*, p. 26).

KNOWN DISTRIBUTION.—Alabama, Colorado, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Maryland, Massachusetts, New Jersey, New York, West Virginia.

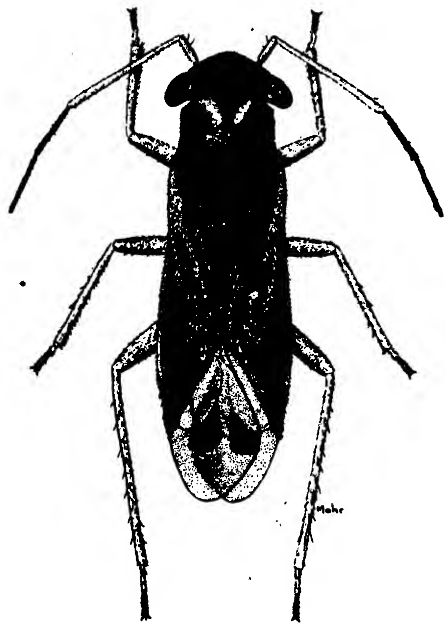


Fig. 140.—*Alepidia gracilis.*

Illinois Records. — GALENA: June 30, 1932, on Austrian pine, Dozier & Mohr, 1 ♀. GALESBURG: July 23, 1893, Scotch pine, 6 ♀. URBANA: July 20, 1889, sweepings, Hart & Terrill, 5 ♂, 1 ♀; July 21, 1889, sweepings in forest, C. A. Hart, 2 ♂, 1 ♀.

Alepidiella Poppius

No Illinois species; *Alepidiella heidemanni* Poppius is known from District of Columbia, Maryland, Oklahoma; occurs on scrub pine (*Pinus virginiana*).

Pilophorus Westwood

KEY TO SPECIES

1. Hemelytra polished over entire width behind posterior silvery line 2

Hemelytra behind posterior silvery line polished on area exterior to radial vein only.................. 8

2. Hemelytra with erect, short, black bristles.......................... 3
Hemelytra clothed only with fine, recumbent pubescence, this pubescence sometimes black, but not erect and bristlelike.............. 4

3. Third antennal segment black, nearly as thick as first segment.......... ....**vanduzeei,** p. 120
Third antennal segment pale, with apical half infuscated, slender, scarcely thicker than fourth segment...............**uhleri,** p. 122

4. Pronotum with silvery, silky and tomentose pubescence; length 5.00... ....**strobicola,** p. 122
Pronotum without silvery, silky and tomentose pubescence............ 5

5. Length 4.50; posterior silvery line not interrupted on corium, but slightly dislocated at claval suture; second antennal segment gradually thickened toward apex..**amoenus,** p. 122
Length not exceeding 3.90; posterior silvery line interrupted on corium but not dislocated at claval suture. 6

6. Second antennal segment strongly clavate on apical one-third........ ....**laetus,** p. 121
Second antennal segment gradually thickened from middle to apex.... 7

7. Third antennal segment dark brown; fourth segment pale. . **taxodii,** p. 121
Third antennal segment pale with apex darkened; fourth segment fuscous............**juniperi,** p. 123

8. Transverse silvery line of clavus and corium continuous and straight, that of clavus bent slightly forward but never disconnected.......... ....**perplexus,** p. 121
Transverse silvery line of clavus and corium dislocated at claval suture or on corium at radial vein........ 9

9. Posterior silvery band widely dislocated at radial vein, inner portion set forward and forming a straight, transverse line with that on clavus; length 3.20.......**geminus,** p. 122
Posterior silvery band not widely dislocated on corium at radial vein, often sloping forward to join band on clavus, but not forming a straight, transverse line with claval band..........................10

10. Hemelytra clothed with fine, soft, recumbent pubescence only........11
Hemelytra bearing sparsely set, erect, short, stiff hairs intermixed with soft, recumbent pubescence......12

11. Length of second antennal segment less than distance between tip of tylus and posterior margin of pronotum; length 3.50. . **walshii,** p. 123
Length of second antennal segment equal to or slightly greater than distance between tip of tylus and posterior margin of pronotum; length 4.00.............**brunneus,** p. 123

12. Length of second antennal segment distinctly greater than distance between tip of tylus and posterior margin of pronotum; clavus with a distinctly darker area bordering scutellum and commissure; length 4.50–5.00..............**clavatus,** p. 124
Length of second antennal segment equal to or only slightly greater than distance between tip of tylus and posterior margin of pronotum; clavus same brown color as corium; length 3.70–3.90.....**setiger,** p. 124

Pilophorus vanduzeei Knight

Pilophorus vanduzeei Knight (1923*d*, p. 540).

MALE.—Length 5.00, width 1.66. Head width 1.25, vertex 0.66, from tip of tylus to basal margin of head 1.11; sharp basal margin of vertex beset with six black bristles, front sparsely clothed with silvery, deciduous and scalelike hairs, which are interspersed with erect bristles. Rostrum, length 2.27, scarcely attaining hind margin of middle coxae. Antennae, first segment, length 0.44, thickness 0.11; second, length 2.22, gradually thickened from base toward apex (0.15 thick), dark brownish black, clothed with short black pubescence; third, length 0.80, thickness 0.08, uniformly black; fourth, length 0.72, pale, infuscated apically. Pronotum, length 0.94, width at base 1.53, anterior angles 0.83; anterior half of disk sparsely clothed with silvery, deciduous pubescence quite similar to that on front of head. Scutellum with apical half and slender lateral margins flat, abruptly convex on basal half but flattened basally, flattened apical half more or less covered with silvery, scalelike pubescence. Hemelytra, dark fus-

co-brownish, opaque anterior to posterior silvery line, basal half with a silvery sheen apparent in certain lights; beset with erect, short, black bristles; posterior silvery line nearly straight, slender, behind this distinctly polished, apex of clavus included. Membrane uniformly darkened with fuscous, an opaque black cloud bordering apex of larger areole. Legs uniformly brownish black, a pale spot on anterior aspect of front coxae near base; hind tibiae strongly flattened and distinctly curved. Venter with a patch of silvery, scalelike pubescence laterally on third segment.

FEMALE.—Length 5.30, width 1.80; very similar to the male, but third antennal segment perceptibly thicker (0.10 thick), nearly equal to thickness of first segment.

HABITS.—Occurs on pines (*Pinus sylvestris* and *P. resinosa*).

KNOWN DISTRIBUTION. — Alabama, Illinois, Iowa, Maryland, Massachusetts, Minnesota, New Jersey, New York, Pennsylvania.

Illinois Records.—ANTIOCH: July 5-7, 1932, T. H. Frison, *et al.*, 1 ♀. GRAND DETOUR: July 2, 1932, Castle Rock, Dozier & Mohr, 1 ♂. STARVED ROCK STATE PARK: July 14, 1932, on Scotch pine, Dozier & Park, 3 ♂. URBANA: June 20, 1932, T. H. Frison, 1 ♀.

Pilophorus laetus Van Duzee

Pilophorus laetus Van Duzee (1918, p. 294).

Not taken in Illinois; breeds on scrub pine (*Pinus virginiana*). Known from Alabama, District of Columbia, Maryland, Massachusetts, New York, Tennessee, Virginia.

Pilophorus perplexus Douglas & Scott

Pilophorus perplexus Douglas & Scott (1875, p. 101).

Not taken in Illinois; known from Connecticut, New York, Nova Scotia, Ontario.

Pilophorus taxodii new species

This species is allied to *juniperi* Knight, but is distinguished by the dark third antennal segment and pale fourth segment.

MALE.—Fig. 141. Length 3.70, width 1.30. Head width 1.03, vertex 0.52. Rostrum, length 1.56, dark brown, reaching to posterior margin of middle coxae. Antennae, first segment, length 0.30, yellowish brown; second, 1.25, yellowish brown, darker on apex, clothed with fine, short, black pubescence; third, 0.47, uniformly brown; fourth, 0.52, pale. Pronotum, length 0.74, width at base 1.12, very dark brown, paler on anterior half, finely rugulose. Mesoscutum and scutellum very dark brown, disk of scutellum strongly convex; bordered with silvery, scalelike pubescence. Hemelytra fulvous to brown, but black behind posterior sil-

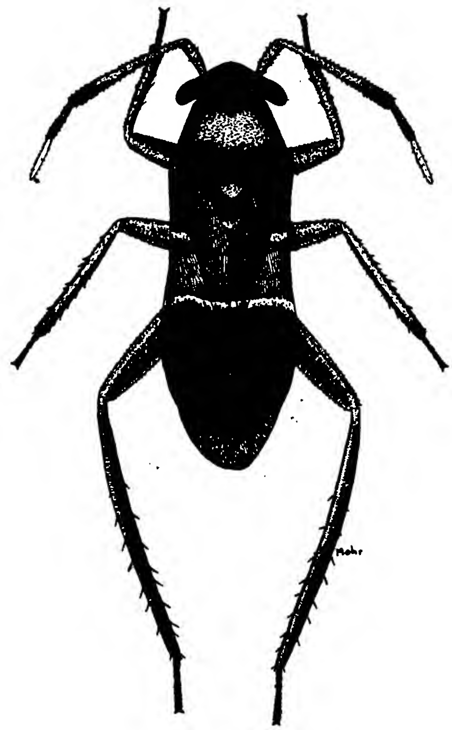


Fig. 141.—*Pilophorus taxodii.*

very line; clothed with fine, short, recumbent, black pubescence; posterior silvery line transverse, nearly straight, not interrupted; basal silvery line restricted to corium and embolium; surface behind posterior silvery line polished, black; pubescence fine, black, cuneus very similar; membrane pale fuscous, an opaque, dull, very dark brown spot covering larger areole and an equal area extending toward middle of membrane. Legs yellowish brown; hind tibiae dark brown, strongly compressed, edges carinate, spines rather short; tarsi fuscous. Venter very dark brown, polished, fulvous brown at base and with a patch of silvery scales on either side at margin of dark color.

FEMALE.—Length 3.90, width 1.30. Slightly more robust than male, but very similar in color and pubescence.

HOST PLANT.—Cypress (*Taxodium distichum*).

Holotype, male.—Karnak, Ill.: June 23, 1932, on cypress, Ross, Dozier & Park.

Allotype, female.—Same data as for holotype.

Paratypes.—ILLINOIS.—Same data as for holotype, 7 ♂, 2 ♀. HORSESHOE LAKE: July 11, 1935, on cypress, DeLong & Ross, 3 ♂, 4 ♀.

Pilophorus geminus Knight

Pilophorus geminus Knight (1926*d*, p. 22).

Not taken in Illinois; known only from Minnesota and Wisconsin.

Pilophorus strobicola Knight

Pilophorus strobicola Knight (1926*d*, p. 19).

MALE.—Length 5.10. Head width 1.06, vertex 0.50. Antennae, first segment, length 0.39; second, 1.94, gradually thickened apically (0.13 thick), dark fusco-brownish, apical half black; third, 0.66, pale fuscous at apex; fourth, 0.61, pale fuscous. Front of head and pronotum clothed with fine, silvery pubescence, that on hemelytra more nearly golden; scutellum clothed with silvery, scalelike pubescence, this pubescence denser at basal angles and apex; hemelytra polished behind posterior silvery line, but rather thickly clothed with recumbent golden pubescence; posterior tibiae distinctly compressed; venter with an oblique patch of silvery, scalelike pubescence on either side of third to sixth sternites.

FEMALE. — Length 5.00, width 1.61. Length of second antennal segment, 2.19, greatest thickness 0.17, more distinctly thickened on apical one-third than in male.

HOST PLANTS.—White pine (*Pinus strobus*) and Scotch pine (*P. sylvestris*), but may be in part predacious.

KNOWN DISTRIBUTION. — Illinois, Iowa, Minnesota, New Hampshire, New York, North Carolina, Ohio.

Illinois Records.—BEACH: Aug. 7, 1935, DeLong & Ross, 1 ♂, 1 ♀. GALESBURG: July 23, 1893, on Scotch pine, 1 ♂, 3 ♀. QUINCY: Aug. 13, 1889, in street, 1 ♂. URBANA: July 20, 1889, sweepings, Hart & Terrill, 1 ♀; June 20, 1892, swept from bluegrass, F. McElfresh, 1 ♂. WHITE PINES FOREST STATE PARK: July 4, 1932, on *Pinus strobus*, Dozier & Mohr, 29 ♂, 15 ♀; July 12, 1934, DeLong & Ross, 5 ♂, 8 ♀.

Pilophorus amoenus Uhler

Pilophorus amoenus Uhler (1887*b*, p. 30).

MALE.—Length 5.00, width 1.64. Antennae, first segment, length 0.39, fuscous; second, 1.83, greatest thickness 0.12, gradually thickened from base to apex, black, fusco-brownish on basal half; third, length 0.72, slender, pale; fourth, length 0.64, pale, dusky on apical half. Hemelytra anterior to posterior silvery line cinnamon fulvous in color; distad of this, polished and piceous; posterior silvery line nearly straight, not interrupted on corium. Hind tibiae distinctly compressed.

FEMALE.—Length 4.80, width 1.70; very similar to male in structure and coloration.

HOST PLANT.—Scrub pine (*Pinus virginiana*).

KNOWN DISTRIBUTION.—District of Columbia, Georgia, Illinois, Maryland, Massachusetts, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Virginia.

Illinois Record.—ILLINOIS: 1 ♀.

Pilophorus uhleri Knight

Pilophorus uhleri Knight (1923*d*, p. 541).

MALE.—Length 5.00, width 1.90. Head width 1.14, vertex 0.53. Rostrum, length 1.80, nearly attaining hind margins of middle coxae. Antennae, first segment, length 0.38; second, 1.86, gradually thickened apically (0.14 thick), brownish to black; third, 0.66, thickness 0.06, pale, apical half infuscated, sometimes tinged with pink; fourth, 0.61, pale, apex dusky. Pronotum, length 0.83, width at base 1.44, uniformly black, bearing a few short, erect bristles. Scutellum covered with silvery, scalelike pubescence on sides and base. Hemelytra dark brown; black and polished behind posterior silvery line; beset with erect, short, black bristles, posterior silvery line transverse, broader than in *vanduzeei* Knight; membrane fusco-brownish, a darker, cloudlike spot covering larger areole and surrounding area.

FEMALE.—Length 4.80, width 1.77; very similar to male in color and pubescence.

HABITS.—Occurs on larch (*Larix laricina*) and Scotch pine (*Pinus sylvestris*).

KNOWN DISTRIBUTION. — Illinois, Iowa, New Jersey, New York, Ontario.

Illinois Records.—ANTIOCH: July 5-7, 1932, on *Larix* sp., T. H. Frison *et al.*, 6 ♀. VOLO: Aug. 24, 1935, DeLong & Ross, 1 ♂.

Pilophorus juniperi Knight

Pilophorus juniperi Knight (1923*d*, p. 543).

This species is allied to *laetus* Van Duzee, but is darker in coloration; it differs in the shorter and more gradually thickened second antennal segment; also in the narrower head.

MALE.—Length 3.70, width 1.30. Head width 0.91, vertex 0.49. Rostrum, length 1.06, attaining middle of intermediate coxae. Antennae, first segment, length 0.28, brownish; second, 1.11, gradually thickened from middle toward apex (0.10 thick), length not equal to distance between tip of tylus and base of pronotum, brown, apical half black; third, length 0.44, pale, infuscated apically; fourth, length 0.42, infuscated. Pronotum, length 0.71, width at base 1.11; very dark brown, sides more gradually sulcate than in *laetus*. General color very dark brown, almost black; hemelytra nearly as in *laetus*, but darker; membrane blackish on basal half, pale fuscous on apical half and on area bordering cuneus; legs fusco-brownish, venter very dark brown, a patch of silvery hairs present on either side of third to fifth sternites.

FEMALE.—Length 3.50, width 1.12. Very similar to male in structure and coloration.

HABITS.—Breeds on red cedar (*Juniperus virginiana*) and may be predacious in habits.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Maryland, Massachusetts, Minnesota, New Jersey, New York, South Dakota.

Illinois Record.—STARVED ROCK STATE PARK: July 14, 1932, on *Juniperus virginiana*, Dozier & Park, 27 ♂, 57 ♀.

Pilophorus walshii Uhler

Pilophorus walshii Uhler (1887*b*, p. 30).

MALE.—Length 3.20, width 1.17; head width 0.82, vertex 0.41. Rostrum, length 0.95, reaching only to near posterior margin of mesosternum. Antennae, first segment, length 0.22, pale, brownish above; second, 0.97, cylindrical, slightly more slender basally, mostly brown; blackish on apical third; third, 0.35, mostly pale, apex fuscous; fourth, 0.32, fuscous. Pronotum, length 0.64, width at base 1.05; from tip of tylus to basal margin of pronotal disk, 1.14. General color dark brown; hemelytra lighter brown; corium behind posterior silvery band and exterior to radial vein dark brown and polished; membrane pale fuscous, a brown cloud covering larger areole and area just behind. Dorsum clothed with short, soft pubescence except for bands; posterior silvery band slightly irregular, widely disconnected at claval suture, that portion on clavus set well forward but transverse in position; basal band thick, just opposite tip of scutellum, extending from costal edge to claval suture; sides of venter with arcuate band of dense, silvery pubescence extending from second to sixth sternites; paracuneus with two spots of silvery pubescence.

FEMALE.—Length 3.70, width 1.30. More robust than male, but very similar in color and pubescence.

HABITS.—Breeds on honey locust (*Gleditsia triacanthos*), but may be in part predacious. A single, probably accidental, specimen was taken in Illinois on apple.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Indiana, Iowa, Maryland, Missouri, Ohio, Virginia.

Illinois Records.—Nineteen males and 31 females, taken June 22 to Sept. 24, are from Darwin, Dubois, Elizabethtown, Galesburg, Kansas, Lawrenceville, Metropolis, Monticello, Murphysboro, Paxton, Pike, Quincy, Rock Island, Savanna, Starved Rock State Park, Urbana, White Heath, Willow Springs. Blatchley (1926*b*, p. 815) records it also from Palos Park.

Pilophorus brunneus Poppius

Pilophorus brunneus Poppius (1914*a*, p. 244).

MALE.—Length 4.00, width 1.40; from tip of tylus to basal margin of pronotum, 1.38. Antennae, first segment, length 0.28, fusco-brownish; second, 1.47, dark brownish, more nearly black at apex; third, 0.61, fuscous, basal one-fourth pale; fourth, 0.61, fuscous, narrow pale area at base. Pronotum, length 0.73, width at base 1.21.

FEMALE.—Length 3.80, width 1.51; from tip of tylus to basal margin of pronotum, 1.33; more robust than male but very similar in pubescence and coloration. Second antennal segment, length 1.33, slightly thicker

toward apex but scarcely exceeding thickness of first segment.

Habits.—Occurs on willow (*Salix* sp.).

Known Distribution.—Illinois, Indiana, Iowa, Maryland, Minnesota, Missouri, New York, Ohio, Ontario.

Illinois Records.—Ten males and 16 females, taken May 29 to Aug. 23, are from Algonquin, Alton, Antioch, Byron, Champaign, Dubois, Eichorn, Kankakee, Meredosia, Savanna, Urbana, Waukegan.

Pilophorus clavatus (Linnaeus)

Cimex clavatus Linnaeus (1767, p. 729).

Male.—Length 4.60, width 1.53; from tip of tylus to basal margin of pronotum, 1.50. Rostrum, length 1.73, reaching to middle of hind coxae. Antennae, first segment, length 0.33, fusco-brownish; second, 1.75, gradually thickened from base toward apex, greatest thickness 0.11, slightly greater than thickness of first segment, dark brownish black, more nearly black on apical half; third, length 0.66, fuscous, pale on basal half; fourth, length 0.39, fuscous, paler at base. Pronotum, length 0.73, width at base 1.40. General color very dark brown, almost black; hemelytra brown; clavus darker than corium except for area bordering claval suture; polished only behind posterior silvery line exterior to radial vein. Dorsum clothed with fine, short, golden and yellowish pubescence intermixed with short, erect, stiff bristles; posterior silvery line dislocated at claval suture, but not disconnected with portion on clavus.

Female.—Length 4.60, width 1.67; from tip of tylus to basal margin of pronotum, 1.55; very similar to male in form, color and pubescence.

Habits.—Occurs on oaks (*Quercus* spp.).

Known Distribution.—This is a European species known in America from British Columbia, Colorado, Illinois, Iowa, Massachusetts, Michigan, Minnesota, New York, North Dakota, Ontario.

Illinois Records.—Illinois: 2 ♀. Cary: Aug. 27, 1905, on oak, W. J. Gerhard, 1 ♂, 2 ♀, fm. Kankakee: Aug. 1, 1933, Ross & Mohr, 1 ♀.

Pilophorus setiger new species

Male.—Length 3.90, width 1.50. Head width 0.91, vertex 0.45. Rostrum, length 1.51, reaching base of hind coxae. Antennae, first segment, length 0.30, yellowish brown; second, 1.34, yellowish, apical one-fourth very dark brown, slender, slightly thicker apically; third, 0.48, pale, apical half fuscous; fourth, 0.39, fuscous. Pronotum, length 0.73, width at base 1.23; from tip of tylus to basal margin of pronotum 1.38. Dorsum clothed with fine, simple, yellowish pubescence intermixed with sparsely set, suberect, bristlelike hairs; posterior silvery band dislocated at claval suture, but still making contact with that part on clavus; basal band thick, extending from costal edge to claval suture at a point very slightly behind tip of scutellum; paracuneus with two silvery patches. General color dark brown to almost black, hemelytra brown, corium dark brown and shining on area behind posterior silvery line and exterior to radial vein, cuneus also dark brown and shining; membrane pale fuscous, a large brown cloud covering larger areole and central area of membrane; legs brown; coxae partly paler; hind tibiae very slightly curved.

Female.—Length 3.90, width 1.50. Very similar to male in general proportions, color and pubescence.

Holotype, male.—Kings Bluff, Winona County, Minn.: June 30, 1922, H. H. Knight, kc.

Allotype, female.—Same data as for holotype, kc.

Paratypes.—Illinois.—Galena: June 30, 1932, Dozier & Mohr, 2 ♀; July 10, 1934, DeLong & Ross, 1 ♂. Palos Park: May 31, 1914, W. J. Gerhard, 1 ♀. Willow Springs: June 9, 1912, 1 ♂; June 28, 1903, 1 ♀; Sept. 4, 1904, W. J. Gerhard, 1 ♀, fm.

South Dakota.—Trail County: Aug. 19, 1923, A. A. Nichol, 1 ♂, kc.

MIRINAE

KEY TO GENERA

1. Pronotum distinctly swollen at middle as wide as or wider than hind margin, fig. 142 2
   Pronotum widest at hind margin, not noticeably swollen at middle, fig. 145 3
2. Length of first antennal segment less than width of vertex; pronotum not extending back to basal angles of hemelytra; base of scutellum poorly defined .... **Pithanus**, p. 125
   Length of first antennal segment

greater than width of vertex, fig. 142; pronotum extending back to basal angles of hemelytra, and hemelytra usually depressed near base and tip of scutellum, arched over middle of abdomen.........**Mimoceps,** p. 125

3. Head strongly exserted with eyes placed near middle, thus far removed from anterior of pronotum, fig. 143. ....**Collaria,** p. 126
   Head not or only slightly exserted; eyes in contact with pronotum or nearly so, fig. 144................. 4
4. Pronotum impunctate or nearly so.... 5
   Pronotum coarsely and deeply punctured.......................... 8
5. Antennal segments thickly covered with long, erect, black hairs, fig. 144; body covered with fine, long, erect pubescence; eyes slightly removed from anterior angles of pronotum... ....**Miris,** p. 127
   Antennal segments clothed with very short pubescence, fig. 145; body nearly glabrous, at most with very short pubescence................. 6
6. Head short and greatly flattened, front scarcely protruding beyond bases of antennae, fig. 145; head with a broad and shallow median basin; first antennal segment slender and curved, thickest near base, tapering to become slender at middle, then becoming slightly enlarged at apex........ ....**Teratocoris,** p. 128
   Head long and pointed, front projecting sharply beyond bases of antennae, compare fig. 144; first antennal segment not formed as above...... 7
7. Rostrum not extending behind middle coxae.........**Trigonotylus,** p. 129
   Rostrum extending to base of abdomen ....**Megaloceroea,** p. 125
8. First antennal segment with very short pubescence, practically glabrous; pronotum and scutellum sparsely covered with deep punctures....... ....**Mesomiris,** p. 131
   First antennal segment thickly covered with long pubescence; punctures of pronotum and scutellum deep and closely placed....**Stenodema,** p. 130

Megaloceroea Fieber

No Illinois species; *Megaloceroea recticornis* (Geoffroy) is apparently an imported European species which has been recognized in British Columbia, Idaho, Iowa, Ontario, Wisconsin. It has not as yet been collected in Illinois, but most likely it will be found here eventually.

Pithanus Fieber

No Illinois species; *Pithanus maerkelii* (Herrich-Schaeffer) is known from British Columbia, Maine, New York, Washington.

Mimoceps Uhler

Mimoceps insignis Uhler

Mimoceps insignis Uhler (1890, p. 84).

MALE.—Length 3.50, width 0.91. Head width 0.82, vertex 0.43. Rostrum, length 1.25, reaching to base of middle coxae. Antennae, first segment, length 0.60, pale, black on base; second, 1.70, pale; third, 1.21, fuscous; fourth, 0.95, fuscous. Pronotum, length 0.78, width at base 0.73; calli large, convex, smooth, occupying middle of disk.

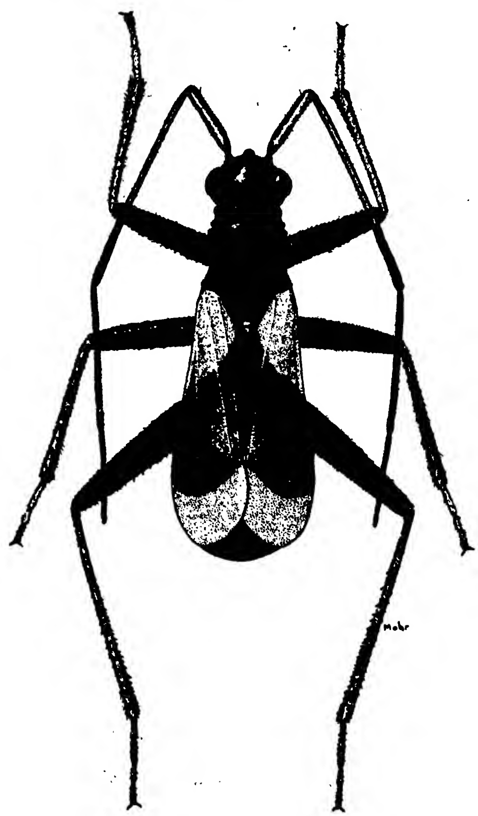


Fig. 142.—*Mimoceps insignis*, brachypterous ♀.

Hemelytra short, membrane absent, apices rounded, covering three-fourths of abdomen, depressed at base, apical half more convex; dorsum glabrous, shining. General color black; white spot present on either side at base of hemelytra; legs pale, femora reddish except at base; coxae fuscous at bases; rostrum pale, except at base and apex.

FEMALE.—BRACHYPTEROUS: Fig. 142. Length 4.50, width 1.30. Head width 0.95, vertex 0.52. Antennae, first segment, length 0.61; second, 1.77. Pronotum, length 0.91, width at base 0.82. Form of hemelytra and coloration similar to male. MACROPTEROUS: Length 4.80, width 1.34. Head width 0.82, vertex 0.43. Antennae, first segment, length 0.61; second, 1.78. Pronotum, length 0.82, width at base 1.08. Hemelytra with membrane developed, fuscous; brachium distinct; cuneus large, outer margin arcuated. Color black; basal half of clavus and corium pale yellowish; legs and rostrum as in male. The macropterous form is rare.

Paler specimens of this species, in which the hemelytra are almost entirely creamy white, belong to the variety *gracilis* Uhler (1890, p. 85).

FOOD PLANTS.—Sedges.

KNOWN DISTRIBUTION.—Colorado, Idaho, Illinois, Iowa, Minnesota, Montana, New Mexico, New York, North Dakota, Ohio, Ontario, Utah, Wisconsin.

Illinois Records.—Four males and 11 females, taken June 10 to Aug. 26, are from Algonquin, Argo, Beach, Champaign, Fox Lake, Galesburg, Grayslake, Palos Park, Rock Island, Volo, Zion.

Collaria Provancher

KEY TO SPECIES

Pronotal disk brown to fuscous, conspicuous black spot present on either side of basal half of disk.......**oculata,** p. 127

Pronotal disk black, black spots obscure ....**meilleurii,** p. 126

Collaria meilleurii Provancher

Collaria meilleurii Provancher (1872, p. 79; 1886, p. 102).

MALE.—Length 6.00–7.00, width 1.70. Head width 1.08, vertex 0.48. Antennae, first segment, length 0.78, yellowish brown, base blackish; second, 4.11, black; third, 2.64; fourth, 1.56. Pronotum, length 0.99, width at base 1.17; calli strongly convex, nearly as high as base of pronotum; basal

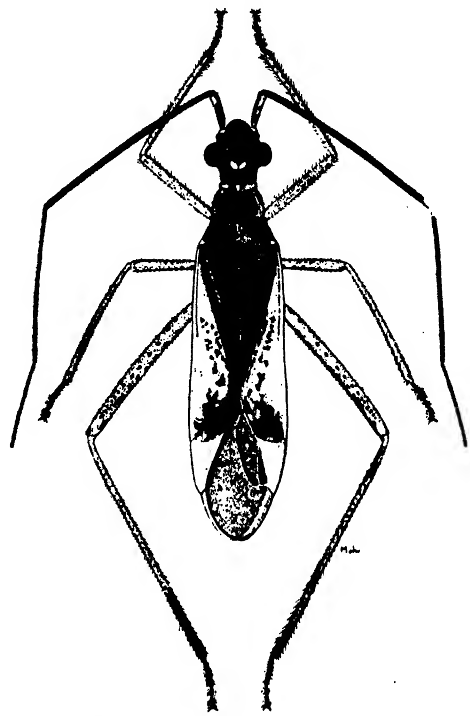


Fig. 143.—*Collaria meilleurii*, ♀.

half of disk with an opaque black spot on either side near basal angle, these spots inconspicuous on the black background. General color black; front of head shining; legs yellowish brown; femora with small, black spots; hemelytra translucent, yellowish; clavus and irregular area on apical half of corium, fuscous to black.

FEMALE.—Fig. 143. More robust than male, but very similar in color and scarcity of pubescence.

HOST PLANTS.—Bluejoint grass (*Calamagrostis canadensis*) and other grasses in damp situations.

KNOWN DISTRIBUTION.—Alberta, Connecticut, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Brunswick, New Hampshire, New York, North Dakota, Ohio, Ontario, Pennsylvania, West Virginia, Wisconsin, Vermont.

Illinois Records. — Twenty-four males and 16 females, taken June 14 to Aug. 4, are from Algonquin, Antioch, Browns, Ce-

dar Lake, Dug Hill, Homer Park, Oakwood, Urbana, Volo, West Union.

Collaria oculata (Reuter)

Trachelomiris oculatus Reuter (1876, p. 61).

MALE.—Length 6.00, width 1.50. Head width 0.93, vertex 0.39. Antennae, first segment, length 0.95; second, 2.84; third, 1.94; clothed with long, pilose hairs. Pronotum, length 0.99, width at base 1.30; disk brownish, a large opaque, black spot each side near basal angle; calli only moderately convex. General color brownish with fuscous; hemelytra chiefly brown; legs pale to brownish yellow; hind femora with seriate fuscous spots on anterior aspect.

FEMALE.—Length 6.75, width 1.75. More robust than the male but very similar in general form and color.

HOST PLANTS.—Occurs on grasses in dry sandy meadows; this species found breeding on panic grass (*Panicum huachucae*) in Virginia.

KNOWN DISTRIBUTION.—Common in the southern United States and known from as far north as Connecticut, Illinois, Indiana, Iowa, New York, Ohio.

Illinois Records.—Thirty-two males and 54 females, taken May 15 to Sept. 30, are from Ashley, Carbondale, Chautauqua Bluff, Clay City, Dixon Springs, Dolson, Dongola, Dubois, Elizabethtown, Fulton, Herod, Mahomet, Meredosia, Murphysboro, Norris City, Odin, Palos Park, Pulaski, St. Anne, Saratoga, Shawneetown, Thebes, Waukegan.

Miris Fabricius

Miris dolabratus (Linnaeus)

Meadow Plant Bug

Cimex dolabratus Linnaeus (1758, p. 449).

ADULTS.—Fig. 144. Length 7.30–8.50, width 2.40. General color pale greenish with fuscous and black markings; pronotum with two black stripes that run over the scutellum; clothed with fine, long, erect pubescence. Brachypterous females common. Females have the second antennal segment uniformly slender, which distinguishes them from *ferrugatus* Fallen.

Darker males of this species, in which the hemelytra are tawny brown, are referable to the variety *aurantiacus* Reuter (1875, p. 16). These and the lighter specimens occur together in Illinois.

FOOD PLANTS.—Bluegrass (*Poa pratensis*), timothy (*Phleum pratense*) and frequently other grasses. A series of specimens was taken in this state on spiderwort (*Tradescantia* sp.). These bugs puncture grass stems, causing the tops of the plants to wilt.

KNOWN DISTRIBUTION.—This is a common European species which is now widely distributed in the eastern United States and

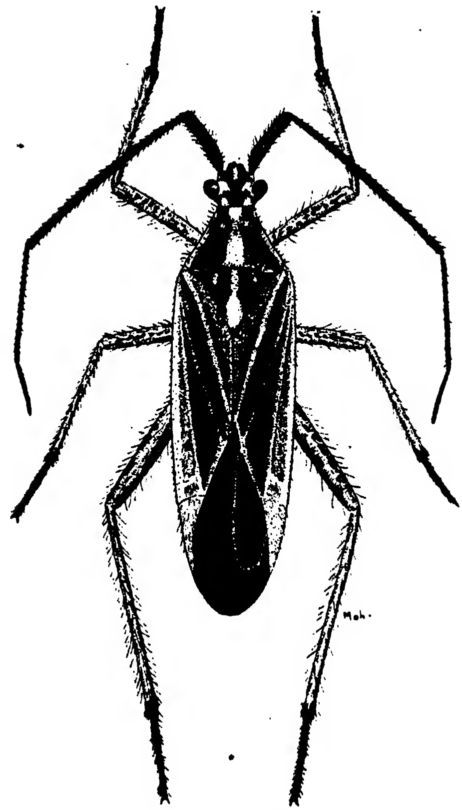


Fig. 144.—*Miris dolabratus*, ♂.

Canada. The fact that this bug is not evenly distributed through the states where it occurs lends evidence to the view that it may have arrived here after the advent of white men.

Illinois Records.—One hundred forty-nine males, 122 females and 2 nymphs, taken May 18 to July 11, are from Algonquin, Amboy, Antioch, Aurora, Custer Park, Danvers, Dixon, East Dubuque, Erie, Freeport, Galena, Glendon Park, Grand Detour, Grandview, Hamilton, Hardin, Harvard,

Joliet, Keithsburg, Lyndon, Mahomet, Marengo, Mount Carroll, Muncie, Oakwood, Oregon, Palos Park, Peoria, Putnam, Quincy, Rock Island, Rockton, St. Anne, St. Joseph, Savanna, Seaton, Seymour, Sheldon, Urbana, Watseka, Waukegan, White Heath, White Pines Forest State Park, Willow Springs, Zion.

Teratocoris Fieber

KEY TO SPECIES

Scutellum and clavus fuscous to black.... .... **discolor**, p. 128
Scutellum and clavus uniformly green.... .... **paludum**, p. 128

Teratocoris discolor Uhler

Teratocoris discolor Uhler (1887*c*, p. 68).

MALE.—Length 4.80, width 1.25. Head width 0.86, vertex 0.38. Rostrum, length 1.17, reaching slightly beyond middle of sternum. Antennae, first segment, length 1.04, thicker on basal half, reddish, blackish at base; second, 2.07, reddish; third, 1.47, fuscous; fourth, 0.99, blackish. Pronotum, length 0.77, width at base 1.04. Tibiae and ventral margins of femora bearing long, pilose hairs. General color pale greenish with fuscous and black areas; basal angles of pronotum, base of hemelytra, and full length of embolium, pale or greenish; legs reddish, bases of femora and tips of coxae paler.

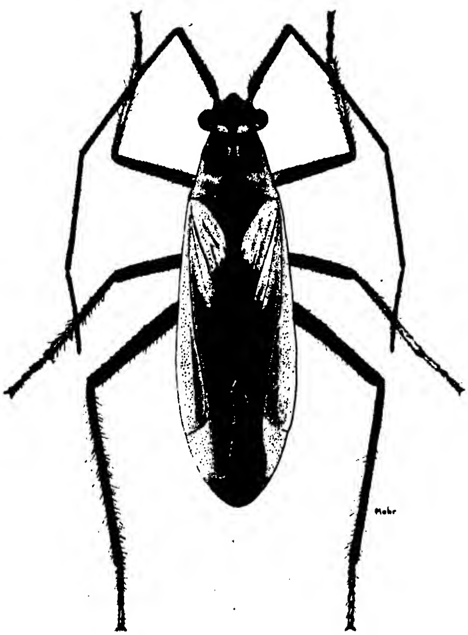


Fig. 145.—*Teratocoris discolor*, ♀.

FEMALE.—Fig. 145. Length 5.60, width 1.64. More robust than male, hemelytra and venter much paler in color; usually only slightly fuscous along claval suture and inner angles of corium, sometimes tinged with reddish.

HOST PLANTS.—Occurs on sedges (*Scirpus* and *Carex*). Frequently collected at lights.

KNOWN DISTRIBUTION.—Colorado, Illinois, Indiana, Iowa, Massachusetts, Michigan, Missouri, Ohio, Ontario, Quebec, South Dakota, Utah.

Illinois Records.—Eleven males and 42 females, taken May 30 to Sept. 8, are from Champaign, Chicago, Galena, Grayslake, Havana, Momence, Odin, Urbana.

Teratocoris paludum J. Sahlberg

Teratocoris paludum J. Sahlberg (1871, p. 291).

MALE.—Length 5.40, width 1.21. Head width 0.78, vertex 0.39. Rostrum, length 1.17, just reaching middle of sternum. Antennae, first segment, length 1.43, thicker on basal half, reddish; second, 2.81, reddish; third, 1.47, fuscous; fourth, 1.08, black. Pronotum, length 0.74, width at base 1.02. General color light green, yellowish on head and mesoscutum; legs green; hind tibiae and tips of femora bright red; hind tibiae with long, pilose hairs.

FEMALE.—Length 5.80, width 1.34. More robust than male, but very similar in coloration.

HOST PLANT.—Occurs on sedge (*Carex vesicaria*), which probably is the plant on which this species breeds. Frequently collected at lights.

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, New York, Ontario, South Dakota; Finland.

Illinois Records.—CHICAGO: May 23, W. J. Gerhard, 3 ♀, FM; June 13, W. J. Gerhard, 1 ♀, FM; May 25, 1906, at light, W. J. Gerhard, 3 ♂, 1 ♀, FM; May 31, 1906, at light, W. J. Gerhard, 1 ♂, FM; July, 1915, W. J. Gerhard, 2 ♂, FM. GRAYSLAKE: Aug. 27, 1932, Ross & Mohr, 2 ♂. HAVANA: May 29, 1936, Mohr & Burks, 1 ♂. URBANA: May 20, 1887, at light, 1 ♀.

Trigonotylus Fieber

KEY TO SPECIES

1. Posterior tarsi and apices of posterior tibiae black..........**tarsalis**, p. 129
   Posterior tarsi and apices of posterior tibiae pale or reddish............. 2
2. Length of first antennal segment less than width of head across eyes..... ....**brevipes**, p. 129
   Length of first antennal segment exceeding width of head across eyes... 3
3. Clavus and corium roseate; second antennal segment pale to yellowish... ....**pulcher**, p. 129
   Clavus and corium pale to dusky or greenish; antennae reddish........ ....**ruficornis**, p. 130

Trigonotylus pulcher Reuter

Trigonotylus pulcher Reuter (1876, p. 59).

MALE.—Length 4.50, width 0.99. Head width 0.62, vertex 0.31. Rostrum, length 1.38, reaching to near apices of middle coxae. Antennae, first segment, length 0.64, thickness 0.15, pale, tinged with roseate; second, length 1.49, pale; third, length 1.31, pale; fourth, length 0.65, brownish. Pronotum, length 0.52, width at base 0.86. General color pale, clavus and corium tinged with roseate; two brown, longitudinal lines on middle of pronotum and scutellum; a roseate to fuscous line present on either side of head along inner margin of eye and extending to basal margin of pronotum.

FEMALE.—Length 5.40, width 1.25. More robust than male, but very similar in coloration.

KNOWN DISTRIBUTION.—Recorded from Minnesota south to Texas and eastward.

Illinois Record.—ANNA: Oct. 11, 1933, Frison & Ross, 1 ♀.

Trigonotylus tarsalis (Reuter)

Callimiris tarsalis Reuter (1876, p. 60).

MALE.—Length 5.40, width 1.12. Head width 0.75, vertex 0.43. Rostrum, length 1.38, reaching nearly to posterior margin of sternum. Antennae, first segment, length 0.80, green; second, 2.34, green, apical half pink; third, 2.60, pink; fourth, 0.95, pink. Pronotum, length 0.65, width at base 0.97. Pubescence very short, dorsum nearly glabrous; tibial spines weak. General color medium green to bright green; apices of posterior tibiae, and tarsi, black; antennae pink to reddish on apical half; membrane pale, veins green.

FEMALE.—Length 6.30, width 1.51. More robust than male, but very similar in form and coloration.

FOOD PLANT. — Slough grass (*Spartina michauxiana*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Kansas, Manitoba, Massachusetts, Minnesota, New Hampshire, North Dakota, South Dakota, Texas, Wisconsin.

Illinois Records.—Fifty-five males and 122 females, taken May 15 to Oct. 1, are from Allerton, Antioch, Argo, Beach, Bondville, Champaign, Chicago, Grayslake, Moline, Momence, Oak Lawn, Ogden, St. Anne, Savanna, Seymour, Urbana, Watseka, Waukegan, Zion.

Trigonotylus brevipes Jakovlev

Trigonotylus brevipes Jakovlev (1880, p. 215).

MALE.—Length 4.10, width 0.95. Head width 0.60, vertex 0.28. Rostrum, length 1.25, reaching to near tips of middle coxae. Antennae, first segment, length 0.51, thickness 0.13, usually greenish yellow, sometimes pink, clothed with short fuscous pubescence; second, length 1.51, cylindrical, 0.07 thick, usually pale yellowish, sometimes pink, clothed with very short, minute pubescence; third, length 1.30, pallid to dusky; fourth, length 0.47, fuscous. Pronotum, length 0.47, width at base 0.82, basal margin broadly concave; disk minutely rugulose, median line slightly elevated, pallid, dusky on each side; calli distinct, a foveate puncture on each inner angle. Dorsal surface nearly glabrous, claval vein and brachium on corium, distinctly elevated. General color pallid to greenish yellow; hemelytra subtranslucent; cuneus nearly clear; membrane sometimes dusky, veins pale to greenish.

FEMALE.—Length 4.85, width 0.96. Slightly larger than the male but very similar in form and coloration.

FOOD PLANTS.—Bermuda grass (*Cynodon dactylon*) and perhaps related grasses.

KNOWN DISTRIBUTION.—Alabama, Arizona, California, Colorado, Connecticut, Florida, Georgia, Illinois, Kentucky, Maryland, New York (coastal), North Carolina, South Carolina, Tennessee, Texas, Utah, Virginia; also Cuba and Mexico.

Illinois Records.—Metropolis: Aug. 17, 1891, Shiga & Hart, 2 ♀; Aug. 20, 1916, C. A. Hart, 1 ♂, 1 ♀.

Trigonotylus ruficornis (Geoffroy)

Cimex ruficornis Geoffroy (1785, p. 209).

Male.—Length 5.30, width 1.17. Head width 0.69, vertex 0.36. Rostrum, length 1.56, reaching to middle of intermediate coxae. Antennae red, first segment often more or less pale; first segment, length 0.73; second, 2.31; third, 1.95; fourth, 0.56. Pronotum, length 0.65, width at base 0.95. Pubescence short on antennae and legs; dorsum practically glabrous. General color pale yellowish green to green; pronotum with four longitudinal, fuscous stripes, median pair extending to apex of scutellum and separated by a slender, pale line; membrane pale to dusky, veins green.

Female.—Length 6.00, width 1.34. More robust than male, but very similar in form and coloration.

Food Plants.—Cultivated oats (*Avena sativa*) and closely related wild grasses.

Known Distribution.—This is a Holarctic species, widely distributed in the United States and Canada, most abundant in the Boreal region.

Illinois Records.—Twenty-two males and 64 females, taken May 22 to Aug. 28, are from Amboy, Antioch, Chicago, Elizabeth, Frankfort, Galena, Grand Detour, Havana, Hoopeston, Macomb, Orangeville, St. Anne, Savanna, Starved Rock State Park, Urbana, Warren, White Pines Forest State Park, Zion.

Stenodema Laporte

KEY TO SPECIES

Hind femora with three strong spines on apical half of posterior margin, fig. 146. .... **trispinosum**, p. 130

Hind femora without spines............ .... **vicinum**, p. 130

Stenodema trispinosum Reuter

Stenodema trispinosum Reuter (1904, pp. 4, 8).

Adults.—Length 7.00–7.50, width 1.70. General color pale yellowish to greenish; hemelytra sometimes bright green; membrane pale, veins green. Dorsum clothed with short, pale pubescence; antennae with prominent pale hairs, first segment more thickly clothed. Pronotum thickly and rather coarsely punctate; median line raised into

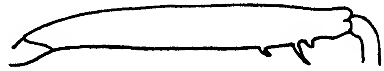


Fig. 146.—*Stenodema trispinosum*, hind femur.

a callus. Posterior margin of hind femora with three spines, one of them much reduced in size.

Food Plants. — Occurs on grasses in moist meadows; adults hibernate.

Known Distribution. — A Holarctic species that is widely distributed in the northern United States and Canada.

Illinois Records.—Fifty-one males and 37 females, taken April 15 to Oct. 6, are from Algonquin, Allerton, Alto Pass, Anna, Antioch, Apple River Canyon State Park, Carbondale, Carmi, Champaign, Chicago, Dubois, Elizabethtown, Fern Cliff, Fountain Bluff, Golconda, Grand Tower, Herod, Jonesboro, Kampsville, Lawrenceville, Mahomet, Mount Carmel, Muncie, Palos Park, Parker, Pulaski, Quincy, Robinson, Shawneetown, Snyder, Springfield, Thebes, Urbana, Vienna, Waukegan.

Stenodema vicinum (Provancher)

Miris vicinus Provancher (1872, p. 77).

Adults.—Length 7.00–7.50, width 1.70. Femora devoid of spines; pronotum and scutellum coarsely and closely punctate, a callous median line evident; first antennal segment thickly clothed with long pubescence, second segment with short pubescence only. General color yellowish to greenish with fuscous markings; dorsum with a median pale stripe and fuscous areas on either side extending from tylus back over pronotum, scutellum and hemelytra; clavus and inner half of corium dark fuscous to blackish in male; antennae reddish, in dark specimens dusky red.

Food Plants.—Occurs on grasses in moist meadows; adults hibernate.

Known Distribution.—This is a common species in the eastern United States and Canada.

Illinois Records.—Fifty-two males, 35 females and 2 nymphs, taken April 26 to Nov. 26, are from Algonquin, Amboy, Apple

River Canyon State Park, Argo, Bowmanville, Chicago, Elizabeth, Fort Sheridan, Galesburg, Geneseo, Ingleside, Lake Villa, Normal, Oquawka, Palos Park, Port Byron, Riverside, Roby, Rockford, Savanna, Urbana, Waukegan, White Pines Forest State Park.

Mesomiris Reuter

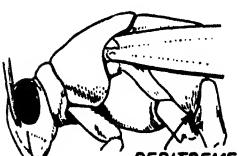
No Illinois species; *Mesomiris curtulus* Reuter is known from Colorado eastward to Pennsylvania and Connecticut. It has not yet been collected in Illinois, but should be found here eventually.

CAPSINAE

KEY TO TRIBES

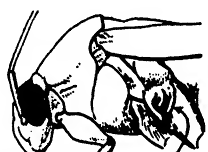
1. Elongate antlike species, figs. 180, 181; abdomen constricted at base; lateral margins of pronotum indistinct, more or less sinuate; emboliar margins of hemelytra recurved ventrad.............................**Myrmecorini,** p. 209

   Not antlike, figs. 154, 155; abdomen not distinctly constricted at base; pronotum with lateral margins distinct, frequently finely carinate; hemelytra with emboliar margins straight or slightly arcuate, not recurved ventrad.................. 2



PERITREME ALMOST ABSENT

147



148 PERITREME LARGE

149

Fig. 147.—Thorax of *Opistheuria clandestina.*

Fig. 148.—Thorax of *Lygus oblineatus.*

Fig. 149.—Prothorax of *Platytylellus fraternus.*

2. Ostiolar peritreme small, indistinct, fig. 147, its dorsal margin scarcely extending dorsad as far as ventral margin of mesepimeron; body impunctate; pronotal collar broad, strongly convex, mesal length of collar usually as great as width of calli...........................**Resthenini,** p. 131

   Ostiolar peritreme prominent, fig. 148, its dorsal margin extending well above ventral margin of mesepimeron; dorsum frequently punctate; pronotal collar not so broad and prominent as above...**Capsini,** p. 136

RESTHENINI

KEY TO GENERA

Stricture of pronotal collar joining base of coxal cleft, fig. 147; head oblique as viewed from side; gula rather long, oblique..............**Opistheuria,** p. 131

Stricture of pronotal collar interrupted at side, not joining directly with base of coxal cleft, fig. 149; head short, vertical; gula short, scarcely apparent.........................**Platytylellus,** p. 132

Opistheuria Reuter

Opistheuria clandestina Van Duzee

Opistheuria clandestina Van Duzee (1915, p. 110).

MALE.—Length 7.00, width 2.80. Head width 1.30, vertex 0.61. Rostrum, length 1.90, reaching to middle of intermediate coxae. Antennae black; first segment, length 1.08, slender, 0.13 thick, clothed with long, suberect, fuscous hairs; second, length 2.20, cylindrical; third, 1.70; fourth, 1.08. Pronotum, length 1.43, width at base 2.20. Emboliar margins distinctly arcuate on apical half. Clothed with erect, rather short, pale pubescence, longer and more fuscous on legs and antennae. Color orange red; antennae, front and tylus, all but central area of disk of scutellum, all but outer margins of hemelytra, and genital segment, black; legs black; coxae reddish; femora more or less pale at base.

FEMALE.—Length 7.10, width 3.00. More robust than male, but very similar in color and pubescence.

All our Illinois specimens but one have the pronotal disk variously marked with black and are referable to the variety *dorsalis* Knight (1918*d*, p. 115); the exception is the single female from West Pullman which has the venter more or less fuscous or black and belongs to the variety *ventralis* Knight (1918*d*, p. 115).

HABITS.—Occurs on willow (*Salix* sp.) and beans (*Phaseolus* spp.).

KNOWN DISTRIBUTION.—Florida, Illinois, Louisiana, Minnesota, New York, North Dakota, Ohio, Oklahoma, Ontario, Wisconsin.

Illinois Records.—GOLCONDA: June 22, 1932, on *Salix* sp., Ross, Dozier & Park, 1 ♂. GRAND DETOUR: June 27, 1906, on willow, 1 ♂, 2 ♀; June 30, 1909, sweeping grass, 1 ♂; July 24, 1905, 2 ♂: Aug. 26, 1889, C. A. Hart, 2 ♂. WEST PULLMAN: July 10, 1910, A. B. Wolcott, 1 ♀, FM.

Platytylellus Reuter

KEY TO SPECIES

1. Length of first antennal segment less than width of vertex............. 2
   Length of first antennal segment equal to or greater than width of vertex.. 4
2. Pronotal disk without median red vitta; length of first antennal segment twice lateral width of an eye. ....**nigricollis**, p. 133
   Pronotal disk with median red vitta that extends to join red area on scutellum...................... 3
3. Hemelytra uniformly black; scutellum red; length 5.00–5.30............ ....**rubrovittatus**, p. 133
   Hemelytra with lateral margins pale to orange colored; commissure pale; scutellum black with a broad, red median line; length 6.20–6.60..... ....**zonatus**, p. 133
4. Pronotum yellow to orange yellow... 5
   Pronotum red, or red with black, or chiefly black................... 7
5. Scutellum black; male genital segment with a prominent tubercle at base of each clasper, as in fig. 150.. ....**nigroscutellatus**, p. 134
   Scutellum orange yellow; male genital segment without tubercles........ 6
6. Width of pronotal collar slightly greater than width of head; length 8.70.**insitivus** var. **insitivus**, p. 133
   Width of pronotal collar less than width of head; length 6.80–8.00... **insitivus** var. **angusticollis**, p. 133
7. Male with a prominent lateral tubercle near base of left genital clasper, fig. 150; both sexes with pronotal disk uniformly red, or red and black; in latter case, black always present along median line, but sometimes black spreads to cover all but narrow area along lateral margins; lateral margins of hemelytra frequently red or pale.................. 8
   Male without tubercle near base of left genital clasper; both sexes usually with pronotal disk black; frequently pronotal disk red and with black, but, in that case, red color present along median line, thus leaving a black ray present on either side; these rays may be reduced to spots near basal margin; lateral margins of hemelytra sometimes red, but, in that case, median line of pronotum red with a black vitta on either side..................11
8. Hemelytra uniformly black......... ...**fraternus** var. **fraternus**, p. 134
   Hemelytra with lateral margins pale or red....................... 9
9. Scutellum uniformly bright red...... .....**fraternus** var. **regalis**, p. 134
   Scutellum black..................10
10. Calli black.................**fraternus** var. **rubromarginatus**, p. 134
    Calli red........................ .....**fraternus** var. **discifer**, p. 134
11. Hemelytra with red lateral margins; pronotal disk red at median line, thus leaving a black or fuscous vitta at either side; vitta sometimes reduced to a black spot near basal margin.....**circumcinctus**, p. 135
    Hemelytra uniformly black.........12
12. Length of first antennal segment equal to width of vertex plus one-third dorsal width of an eye; length 7.90...........**rubellicollis**, p. 136
    Length of first antennal segment only slightly greater than width of vertex, less than width of vertex plus one-third dorsal width of an eye; length 7.70, or less.............13
13. Head black, basal margin of vertex with a narrow red line; pronotal collar red, with usually a black area above; base of venter red beneath; gula never red; surface coarsely granulate.........**borealis**, p. 136
    Head red, tylus and variable areas on juga and lora black; surface very finely granulate.................14
14. Venter black, with not more than a red tinge at base; scutellum red, lateral margins black; pronotal disk

with a broad central red area, this area not forming a clearly defined vitta; length 6.70–7.50............................. **insignis**, p. 135

Venter red; scutellum black; basal half of pronotal disk black; length 5.10–5.80....... **fraterculus**, p. 136

Platytylellus rubrovittatus (Stål)

Resthenia rubrovittata Stål (1862, p. 318).

MALE.—Length 5.00, width 1.70; emboliar margins moderately arcuate; surface distinctly granulate. Head width 1.08, vertex 0.51. Antennae, first segment, length 0.44; second 1.71, cylindrical, nearly as thick as first; third, 1.26; fourth, 0.81. General color black; head except tylus and eyes, basal segment of rostrum, pronotum except a flaring ray extending from callus to basal margin on either side of disk, scutellum, mesoscutum except outer angles, sternum except cloud on either side, pleura, venter except vagina exterior, coxae, femora except narrow area at base and apical one-third, red or orange red.

FEMALE.—Length 5.30, width 2.00; very similar to male in coloration; second antennal segment slightly more slender and less cylindrical.

HOST PLANT.—Collected on willow (*Salix* sp.).

KNOWN DISTRIBUTION.—Originally described from a single male specimen with the locality given as "boreal America." Now known from Nova Scotia southward to Florida and westward to Texas.

Illinois Records.—ALDRIDGE: Aug. 11, 1891, sweepings, Mississippi bottoms, Hart & Shiga, 1 ♂. GOLCONDA: June 22, 1932, on *Salix* sp., Ross, Dozier & Park, 5 ♂, 3 ♀. GRAND TOWER: July 12, 1909, on willow, 1 ♂. KARNAK: July 10, 1935, DeLong & Ross, 1 ♂. URBANA: Aug. 17, 1916, 1 ♂.

Platytylellus nigricollis (Reuter)

Resthenia nigricollis Reuter (1876, p. 65).

MALE.—Length 6.00, width 2.30. Head width 1.14, vertex 0.66, lateral width of eye 0.28. Rostrum, length 2.20, reaching to middle of hind coxae. Antennae, first segment, length 0.58; second, 1.76; third, 1.14; fourth, 0.90. Pronotum, length 1.04, width at base 1.82. Surface rather coarsely and thickly granulate, clothed with short, black pubescence. General color black; head except tylus, collar, xyphus, and sides of pronotum, scutellum except basal angles, sternum except cloud on either side of median line, pleura, venter except beneath on genital segment, red; legs black; coxae and basal one-third of hind femora pale to red.

FEMALE.—Length 6.40, width 2.60; very similar to male in color, pubescence and surface granulation.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Indiana, Iowa, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Ontario, Pennsylvania, Texas, Virginia.

Illinois Records.—ANTIOCH: July 5-7, 1932, T. H. Frison *et al.*, 1 ♂, 1 ♀. GRAND DETOUR: July 2, 1932, Dozier & Mohr, 1 ♂.

Platytylellus zonatus Knight

Platytylellus zonatus Knight (1926*h*, p. 254).

MALE.—Length 6.20, width 2.40. Head width 1.26, vertex 0.68. Rostrum, length 2.20, just attaining bases of hind coxae. Antennae, first segment, length 0.58; second, 2.00; third, 1.46; fourth, 0.77. Pronotum, length 1.31, width at base 2.10. General color black; vertex except for lunate marks, lower half of face except tylus and apex of lora, collar, lateral margins and median line of pronotum, and median one-third of scutellum, orange red; embolium and narrow outer margin of corium, outer half of cuneus, and commissure of hemelytra, orange colored. Variable areas on pleura and sides of venter orange obscured with blackish. Femora yellowish to orange, with anterior and posterior faces obscured with fuscous. Body surface covered with fine granules, and thickly clothed with fine, short, yellowish to fuscous pubescence. Genital segment without tubercles.

FEMALE.—Length 6.60, width 2.60. Slightly more robust than male, but very similar in coloration and pubescence.

KNOWN DISTRIBUTION.—Illinois, Manitoba, Michigan, Minnesota, North Dakota, Wisconsin.

Illinois Records.—ANTIOCH: July 5-7, 1932, T. H. Frison *et al.*, 3 ♂.

Platytylellus insitivus (Say)

Capsus insitivus Say (1832, p. 21; 1859, p. 340).

MALE.—Length 8.70, width 3.60. General color black, pronotum and scutellum orange yellow; surface very finely granulate,

opaque, with short pubescence; width of collar greater than width of head. Head width 1.36, vertex 0.81. Width of collar 1.40. Rostrum, length 2.40, attaining tips of middle coxae. Antennae, first segment length 1.07; second, 3.00, nearly cylindrical, length of hairs not equal to thickness of segment; third, 1.98; fourth, 0.94. Pronotum, length 1.73, width at base 2.77

FEMALE.—Length 8.70, width 3.50; very similar to male in form and coloration.

The single male from Palos Park, listed below, which is smaller in size and has the width of the head greater than the width of the collar, belongs to the variety *angusticollis* Knight (1923*d*, p. 556). It may prove to be biologically distinct from the typical form.

KNOWN DISTRIBUTION.—Connecticut, Florida, Illinois, Indiana, Iowa, New Jersey, New York, Ontario, Pennsylvania.

Illinois Records.—GALENA: June 27, 1928, T. H. Frison, 1 ♂; June 30, 1932, Dozier & Mohr, 2 ♂. GALESBURG: June 21, 1892, Stromberg, 2 ♀; June 27, 1893, Stromberg, 2 ♀. HARDIN: June 5-9, 1932, H. L. Dozier, 2 ♂, 2 ♀. PALOS PARK: June 19, 1933, Ross & Mohr, 1 ♂. ROCK ISLAND: 1880, 1 ♀. WILLOW SPRINGS: July 12, 1903, W. J. Gerhard, 1 ♂, FM.

Platytylellus nigroscutellatus Knight

Platytylellus nigroscutellatus Knight (1923*d*, p. 557).

MALE.—Length 9.20, width 3.70. Head width 1.71, vertex 0.94; black with gula, genae, bucculae, and margins of lora and juga, orange yellow. Rostrum black, length 3.10, extending slightly beyond hind margins of middle coxae. Antennae black; first segment, length 1.19, clothed with erect, almost pilose hairs, length of hairs not exceeding thickness of segment; second, 3.43, cylindrical, strongly pubescent, a few erect hairs near base as long as thickness of segment; third, 1.66; fourth, 0.94. Pronotum, length 1.89, width at base 2.94, collar 1.36; uniformly orange yellow, finely granulate, clothed with short, erect, pale pubescence. Scutellum black; sternum blackish; pleura orange yellow, becoming fuscous on central area of metepisternum. Hemelytra, emboliar margins very slightly arcuate for most of their length; black, faintly shining, clothed with very fine, short pubescence. Legs black; tibiae clothed with erect, prominent hairs, length of many hairs exceeding thickness of segment; spines not evident. Venter black, with a velvety luster; clothed with erect, fine, dusky pubescence.

FEMALE.—Length 9.70, width 3.50. Very similar to male in form and color.

KNOWN DISTRIBUTION.—Illinois, Michigan, New York, North Carolina, Pennsylvania.

Illinois Record.—HEYWORTH: Aug. 14, 1909, A. B. Wolcott, 1 ♀, FM.

Platytylellus fraternus Knight

Platytylellus fraternus Knight (1923*d*, p. 557).

The color pattern of this form is suggestive of that of *confraternus* (Uhler), but this is larger, and the length of the first antennal segment is equal to the width of the vertex plus one-half the dorsal width of an eye.

MALE.—Length 9.40, width 3.50. Head width 1.56, vertex 0.86; red, with tylus, front and vertex chiefly black. Rostrum, length 2.85, reaching to middle of hind coxae. Antennae, first segment, length 1.06; second, 3.23, thickest near base and tapering to become more slender at apex, clothed with short, stiff, black hairs and fine pubescence, length of longest hairs not exceeding thickness of segment; third, 1.71; fourth, 1.28. Pronotum, length 1.74, width at base 2.92, collar 1.31; surface very slightly shining, thickly clothed with short, pale pubescence; red, with dorsal area of collar, calli except at outer angles, and a broad band extending to basal margin of disk, black. Scutellum black; sternum blackish, median line red; pleura red or becoming dusky. Hemelytra with emboliar margins only slightly arcuate; black, opaque, surface somewhat scabriculous, clothed with

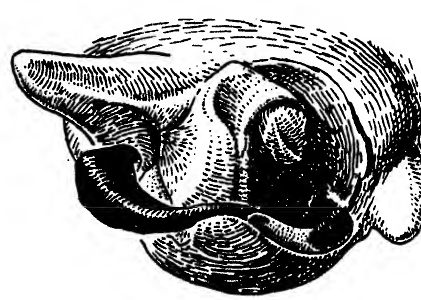


Fig. 150.—Male genitalia of *Platytylellus fraternus.*

short, dusky pubescence, hairs somewhat decumbent on apical half. Legs black, thickly clothed with prominent, erect hairs. Venter red; genital segment becoming black; a large, prominent, erect tubercle present just

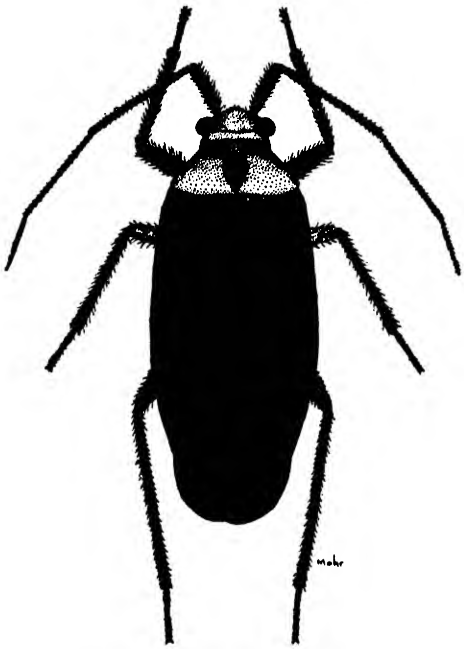


Fig. 151.—*Platytylellus fraternus*, ♀.

above base of left genital clasper, and another, smaller tubercle directed distad from near base of right clasper, fig. 150.

FEMALE.—Fig. 151. Length 9.10, width 3.50. Pronotum, length 1.52, width at base 2.64. Similar to male in form and color.

This species varies greatly in color, and many color combinations have been given varietal names. The typical form and variety *rubromarginatus* Knight (1923*d*, p. 558) have been recognized in Illinois material; varieties *regalis* Knight (1923*d*, p. 559) and *discifer* Knight (1923*d*, p. 559) have not.

HOST PLANT.—Apparently breeds on sumach (*Rhus aromatica*).

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Florida, Georgia, Illinois, Maryland, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, Virginia, West Virginia.

Illinois Records.—BISHOP: June 23, 1906, 1 ♂, 1 ♀. BLUFF SPRINGS: June 10, 1932, Ross & Mohr, 4 ♂, 10 ♀. FOREST CITY: June 6, 1905, 1 ♂. HARDIN: June 5-9, 1932, H. L. Dozier, 2 ♀. HAVANA: June 3, 1918, 1 ♀; June 8, 1905, Devil's Hole, 2 ♂; June 23, 1926, Devil's Hole, Frison & Hayes, 22 ♂, 12 ♀. KEITHSBURG: June 15, 1932, on *Rhus aromatica*, H. L. Dozier, 22 ♂, 7 ♀. MAKANDA: June 26, 1909, sweepings, 1 ♂. NORMAL: 1 ♂.

Platytylellus circumcinctus (Say)

Capsus circumcinctus Say (1832, p. 23; 1859, p. 343).

MALE.—Length 7.10, width 2.70. Head width 1.28, vertex 0.71. Antennae, first segment, length 0.77; second, 2.34; third, 1.54; fourth, 0.95. Head red, with front and tylus blackish and juga and lora more or less black; pronotum red; calli blackish, a flaring black ray located behind each callus and extending to basal margin of disk; scutellum and mososcutum red, basal angles black; pleura red; sternum reddish, but becoming blackish on either side of median line; hemelytra black; embolium, outer margin of corium and cuneus red; legs black, tinged with reddish near bases of femora; venter chiefly red with genital segment and variable areas at sides black.

FEMALE.—Length 7.40, width 2.70. More robust than male, but very similar in coloration.

KNOWN DISTRIBUTION.—Originally described from Indiana, and now known from District of Columbia, Illinois, Maine, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Virginia.

Illinois Records.—DOLSON: June 25, 1932, Rocky Branch, Frison & Mohr, 1 ♂. OAKWOOD: June 16, 1925, T. H. Frison, 1 ♂.

Platytylellus insignis (Say)

Capsus insignis Say (1832, p. 22; 1859, p. 342).

MALE.—Length 6.70, width 2.60. Head width 1.19, vertex 0.67. Antennae, first segment, length 0.74; second, 2.20; third, 1.54; fourth, 0.97. General color black, opaque; finely granulate; head red, tylus and variable areas on juga and lora blackish; pronotum red, basal half of disk largely blackish, but broad central area of disk red, this red area not forming a clearly defined vitta; scutellum red, lateral margins blackish; ven-

ter black with not more than a red tinge at base.

FEMALE.—Length 7.60, width 2.80. Larger and more robust than male, but very similar in coloration.

KNOWN DISTRIBUTION.—Common over the eastern United States.

Illinois Record.—WEST PULLMAN: July 13, 1902, W. J. Gerhard, 1 ♀, FM.

Platytylellus fraterculus Knight

Platytylellus insignis fraterculus Knight (1923*d*, p. 554).

MALE.—Length 5.10, width 1.90. Head width 1.00, vertex 0.51; red, tylus blackish. Rostrum, length 1.69, black, basal segment red. Antennae, first segment, length 0.51; second, 1.90; third, 1.43; fourth, 0.80. Pronotum, length 0.90, width at base 1.60; bright red; disk black from just behind calli to basal margin and with a very slight indication of median vitta. Scutellum black; sternum and pleura red. Hemelytra black, very slightly shining; thickly clothed with fine dusky pubescence, hairs recumbent on apical half. Legs black with red coxae. Venter uniformly red and genital claspers black.

FEMALE.—Length 5.60, width 2.00. Slightly larger and more robust than male, but similar in coloration.

KNOWN DISTRIBUTION. — Illinois, Indiana, Michigan, Minnesota, Ontario, Pennsylvania, Wisconsin.

Illinois Record.—NORTHERN ILLINOIS: Bolter, 1 ♀.

Platytylellus borealis Knight

Platytylellus borealis Knight (1923*d*, p. 553).

Not taken in Illinois; known from Alberta, Maine, Manitoba, Michigan, Minnesota, New York, North Dakota, Ontario, Vermont.

Platytylellus rubellicollis Knight

Platytylellus rubellicollis Knight (1923*d*, p. 555).

Not taken in Illinois; known from British Columbia, Maine, Michigan, Minnesota, Nebraska. Nymphs and adults of this species have been collected on the figwort (*Scrophularia leporella*), but it has not been proved that this plant is normally their host.

CAPSINI

KEY TO GENERA

1. Pronotum punctate, sometimes only very finely punctate but usually distinctly so; strongly shining, calli usually prominent, figs. 152, 153. . 2
   Pronotum impunctate, or with fine aciculate punctures only. 11

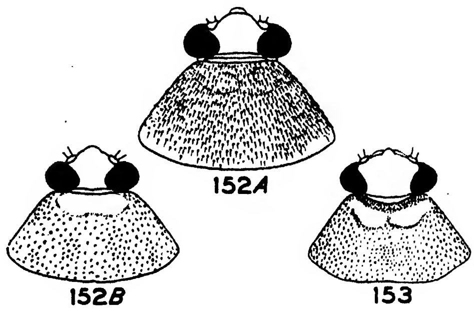


Fig. 152.—*A*, head and pronotum of *Neolygus invitus*; *B*, head and pronotum of *Lygus oblineatus.*

Fig. 153.—Head and pronotum of *Neoborus glaber.*

2. Second antennal segment clavate, fig. 154; juga tumidly convex; vertex broad, transversely striolate on either side near eyes; short oval, convex, chiefly black species. . . . . **Capsus,** p. 138
   Second antennal segment linear or practically so, fig. 155. 3
3. Pronotum punctate between calli and posterior to collar. 4
   Pronotum impunctate between calli and posterior to collar. 6
4. Lateral margins of pronotum not carinate; form more elongate and subparallel. . . . . **Xenoborus,** p. 143
   Lateral margins of pronotum carinate or at least with a calloused line; form ovoid. 5
5. First antennal segment distinctly thicker than second segment and both segments black; body color red and black. . . . . **Tropidosteptes,** p. 139
   First antennal segment slender, scarcely equaling thickness of second segment at apex; if body colored reddish, first and second antennal segments pale or yellowish. **Neoborus** p. 139

6. First and second antennal segments thickly clothed with heavy black pubescence, fig. 155; large red species, length 8.00.............. ....**Coccobaphes,** p. 138
   First antennal segment more sparsely clothed with pale pubescence, fig. 156; size less than 7.50........... 7
7. Pronotum with lateral margins sharply angulate, carinate near posterior angle; body red and black, fig. 159. ....**Neocapsus,** p. 147
   Pronotum with lateral margins rounded or angulate, but not carinate... 8
8. Rostrum extending to fourth or fifth abdominal sternite; dorsum glabrous...........**Platylygus,** p. 147
   Rostrum rarely extending beyond tips of hind coxae; if so, then dorsum distinctly pubescent............. 9
9. Pronotum very finely punctate, fig. 152*A*; body integument more thinly chitinized, more fragile.......... ....**Neolygus,** p. 154
   Pronotum coarsely, or at least distinctly punctate, fig. 152*B*; body integument heavily chitinized.....10
10. Second antennal segment distinctly more slender at base, fig. 162; lateral margins of pronotum angulate. ....**Lygus,** p. 148
    Second antennal segment cylindrical, scarcely more slender at base, fig. 158; lateral margins of pronotum rounded...........**Lygidea,** p. 145
11. First antennal segment thickened, clothed with numerous flattened hairs, fig. 172. .**Neurocolpus,** p. 181
    First antennal segment devoid of flattened hairs, fig. 170...........12
12. Pronotum with two subexcavated, dull, black spots situated behind the callosities, fig. 170; first antennal segment clothed with long black hairs and setae................. ....**Paracalocoris,** p. 176
    Pronotum without black spots, or with only superficial ones, and with first antennal segment without prominent, long, black setae; length of hairs on first antennal segment rarely exceeding thickness of segment.........................13
13. Second antennal segment thickened; somewhat spindle shaped, fig. 171 ....**Garganus,** p. 181
    Second antennal segment linear, or only very slightly thickened at tip, fig. 168.........................14
14. Hind femora long, extending much beyond tip of abdomen, and flattened, broadest before middle and more slender at apex, fig. 177.......... ....**Phytocoris,** p. 184
    Hind femora shorter, not or scarcely extending beyond tip of abdomen, fig. 169........................15
15. First segment of hind tarsus distinctly longer than third.......... ....**Stenotus,** p. 175
    First segment of hind tarsus shorter than third.....................16
16. Dorsal surface distinctly pubescent, dull, fig. 166....................17
    Dorsal surface glabrous, highly polished, fig. 167..................20
17. Body above and below clothed with silky or woolly pubescence....... ....**Polymerus,** p. 166
    Body clothed only with simple pubescence, never woolly.............18
18. Head broad, eyes practically in contact with pronotal angles, hind margins of eyes somewhat flattened and forming an arcuate line with base of vertex, fig. 166........... ....**Dichrooscytus,** p. 165
    Head not unusually broad, eyes convex behind and well removed from pronotal angles, fig. 168..........19
19. Thickness of fourth antennal segment almost equal to that of base of second segment; mesal length of collar subequal to thickness of fourth antennal segment, fig. 168.. ....**Adelphocoris,** p. 174
    Fourth antennal segment distinctly thinner than base of second segment; mesal length of collar distinctly greater than thickness of fourth segment....**Calocoris,** p. 137
20. Rostrum short, scarcely surpassing anterior coxae................. ....**Poecilocapsus,** p. 172
    Rostrum longer, at least reaching posterior margins of middle coxae.. ....**Horcias,** p. 172

Calocoris Fieber

No Illinois species; *Calocoris norvegicus* (Gmelin) is a European species now known

from Connecticut, Maine, Massachusetts, New Jersey, New York, Nova Scotia, Quebec, where it occurs on grasses.

Capsus Fabricius

KEY TO SPECIES

Second antennal segment strongly clavate on apical half, thickness nearly twice that of first segment, fig. 154 .... **ater,** p. 138

Second antennal segment only moderately clavate on apical half, thickness only slightly greater than that of first segment .... **simulans,** p. 138

Capsus ater (Linnaeus)

Cimex ater Linnaeus (1758, p. 447).

MALE.—Length 5.70, width 2.60. Head width 1.43, vertex 0.75. Antennae, first segment, length 0.65, thickness 0.13; second, 1.86, strongly clavate, greatest thickness 0.22; third, 0.73, slender; fourth, 0.91. Pronotum, length 1.21, width at base 2.03. Head and body uniformly black, moderately shining; the pronotum shallowly, but rather coarsely, punctate; clothed with pale to yellowish pubescence.

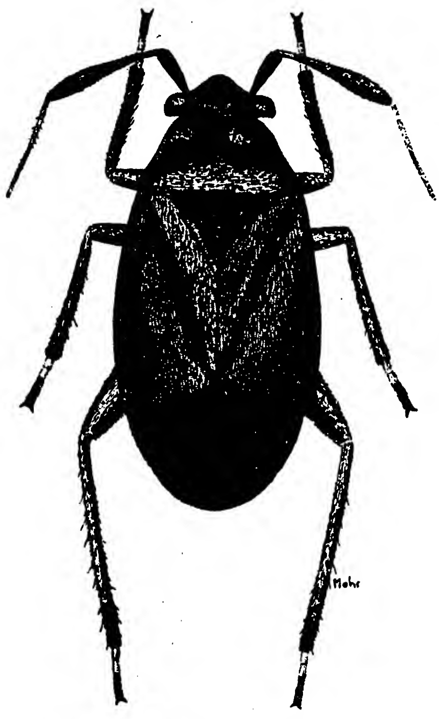


Fig. 154.—*Capsus ater*, ♀.

FEMALE.—Fig. 154. Length 5.80, width 3.10. Very similar to male in color, pubescence and punctation.

The typical form of this species has black legs, variety *tyrannus* (Fabricius) (1794, p. 177) has yellow brown or reddish legs, and variety *semiflavus* (Linnaeus) (1767, p. 725) has the legs, head and pronotum reddish. All three forms and their intergrades have been taken together in Illinois. All Illinois specimens with the reddish head and pronotum are females.

FOOD PLANTS.—Canada bluegrass (*Poa compressa*), couch grass (*Agropyron repens*); occasionally other grasses, such as timothy (*Phleum pratense*).

KNOWN DISTRIBUTION.—This European species is common throughout the eastern United States and Canada.

Illinois Records.—One hundred fifteen males, 67 females and 1 nymph, taken May 13 to Aug. 12, are from Algonquin, Amboy, Antioch, Aurora, Bloomington, Chicago, Des Plaines, East Dubuque, Edgebrook, Elizabeth, Erie, Fort Sheridan, Frankfort, Freeport, Galena, Galesburg, Glendon Park, Glen Ellyn, Grayslake, Harvard, Havana, Joliet, Monticello, Normal, Oregon, Palos Park, Pecatonica, Rock Island, Savanna, Starved Rock State Park, Urbana, Willow Springs.

Capsus simulans (Stål)

Deraeocoris simulans Stål (1858, p. 186).

This species is distinguished from *ater* (Linnaeus) by its more slender second antennal segment. It is a palearctic form that feeds on brome grass (*Bromus inermis*) and has been found in Alaska, Alberta, Iowa, Minnesota, Montana, South Dakota, Wyoming. Not as yet found in Illinois, but it should be taken here eventually.

Coccobaphes Uhler

Coccobaphes sanguinareus Uhler

Coccobaphes sanguinareus Uhler (1878, p. 401).

ADULTS.—Fig. 155. Length 7.50, width 3.40. General color bright red with a dusky space either side of hemelytral commissure; membrane, first two segments of antennae, tibiae, and apices of tarsi, black; third an-

tennal segment pale; fourth segment fuscous.

FOOD PLANTS.—Sugar maple (*Acer saccharum*) and occasionally red maple (*A.*

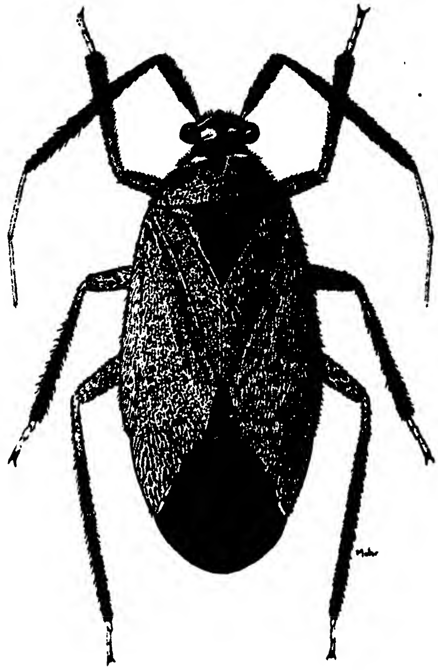


Fig. 155.—*Coccobaphes sanguinareus.*

rubrum); breeds most abundantly on second growth or young trees.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Ontario, Pennsylvania, Tennessee, Vermont, Wisconsin.

Illinois Records.—Nine males and 7 females, taken May 24 to Aug. 9, are from Carbondale, Champaign, Elizabethtown, Hardin, Herod, Makanda, Urbana.

Tropidosteptes Uhler

Tropidosteptes cardinalis Uhler

Tropidosteptes cardinalis Uhler (1878, p. 404).

ADULTS.—Length 5.50, width 2.60; general color bright red with antennae, tylus, legs except apices of front and middle femora, space on either side of commissure of hemelytra, and membrane, black.

FOOD PLANT.—White ash (*Fraxinus americana*) and occasionally other species of ash; occurs most frequently on young trees.

KNOWN DISTRIBUTION.—Connecticut, Florida, Illinois, Iowa, Massachusetts, Michigan, Mississippi, New Hampshire, New Jersey, New York, Ohio, Ontario, Pennsylvania, Texas, Vermont.

Illinois Records.—DUBOIS: May 14, 1916, 1 ♀; May 15, 1916, 2 ♂; May 21, 1917, 3 ♂, 5 ♀; May 23, 1917, 1 ♂, 2 ♀; May 24, 1917, 1 ♂. FRANKFORT: June 8, 1933, Mohr & Townsend, 4 ♂, 2 ♀, HEROD: May 29, 1936, Ross & Mohr, 1 ♀. URBANA: June 3, 1906, on elder, 1 ♀.

Neoborus Reuter

KEY TO SPECIES

1. Dorsum practically glabrous........ 2
   Dorsum strongly pubescent......... 8
2. Rostrum attaining hind margins of middle coxae; a black line bordering outer margin of radius and curving mesad across apical area of corium..............**palmeri,** p. 141
   Rostrum not extending beyond posterior margin of mesosternum..... 3
3. Antennae very dark brown; scutellum dark brown, basal angles pale; hemelytra dark brown to pitch black, pale or yellowish at base of corium and embolium and on areas extending along radius......**glaber,** p. 140
   First antennal segment pale, rarely somewhat dusky................ 4
4. Dorsum uniformly black with cuneus pale, except apically, and membrane black; sometimes with a small pale spot at base of corium.. ....**geminus,** p. 140
   Dorsum more or less pale, frequently marked with red; scutellum usually with some pale or yellow, but, if black, then membrane and cuneus pale......................... 5
5. Chiefly pale, with apical area of corium reddish.................... ....**amoenus** var. **amoenus,** p. 140
   Chiefly black or very dark brown, almost black................... 6
6. Membrane slightly smoky, paler on area bordering apex of cuneus.... ...**amoenus** var. **scutellaris,** p. 140
   Membrane entirely pale............ 7
7. Very dark brown, almost black; lateral

and median vittae on pronotal disk, all of scutellum except basal angles and median line at base, and corium, more or less pale............ ....**amoenus** var. **signatus,** p. 140
Black; only cuneus and membrane pale.......................... ...**amoenus** var. **atriscutis,** p. 140

8. First antennal segment black......... 9
First antennal segment pale........11
9. Scutellum very dark brown on either side of median line, basal angles paler; hemelytra translucent reddish brown; cuneus colored similarly to corium.......**rufusculus,** p. 143
Scutellum testaceous, sometimes brownish on middle at base, never black with median line paler......10
10. Second antennal segment yellowish brown, sometimes black near base; cuneus translucent yellowish to brownish.......**canadensis,** p. 141
Second antennal segment uniformly black; cuneus clear and translucent ....**populi,** p. 142
11. Dorsum uniformly black, cuneus clear, legs pale......**tricolor,** p. 143
Dorsum more or less pale, scutellum always partly yellowish..........12
12. Scutellum with a median black line extending from base to apex; female with embolium and outer margin of corium black and inner apical angle of corium dull yellow brown...... ....**vittiscutis,** p. 142
Scutellum yellow, sometimes dark at middle of base, but never with a median black line; female with inner apical angle of corium black and embolium chiefly pale........ ....**pubescens,** p. 141

Neoborus geminus (Say)

Capsus geminus Say (1832, p. 24; 1859, p. 344).

ADULTS.—Length 4.80–5.30, width 2.20. General color deep black, shining; legs, first antennal segment and base of second, and cuneus except apex, pale; front of head usually with pale marks.

FOOD PLANT.—White ash (*Fraxinus americana*). Usually occurs with *amoenus* (Reuter) during June.

KNOWN DISTRIBUTION.—Described from Indiana and since recognized from Illinois, Ohio, Ontario, New York.

Illinois Records.—GALESBURG: June 8, 1893, 1 ♀. SHAWNEETOWN: May 27, 1928, T. H. Frison, 1 ♂.

Neoborus amoenus (Reuter)

Tropidosteptes amoenus Reuter (1909, p. 48).

ADULTS.—Length 4.30–5.00, width 2.00. General color pale yellowish, marked with reddish and fuscous, and sometimes with black; pronotum with five to seven fuscous or reddish rays, clavus and apical area of corium marked with bright red, sometimes tinged with fuscous; apex of second antennal segment and sometimes third and fourth fuscous.

The typical form of this species is mostly pale; darker specimens may be designated by varietal names. Of these, *amoenus signatus* (Reuter) (1909, p. 49) and *scutellaris* (Reuter) (1909, p. 49) and intergrading forms have been taken together in Illinois; variety *atriscutis* Knight (1929*c*, p. 10) has not yet been taken in the state.

FOOD PLANTS. — White ash (*Fraxinus americana*) and red ash (*F. pennsylvanica*), especially the latter. Nymphs occur on the trees from May to September; there are apparently two broods per year.

KNOWN DISTRIBUTION.—Common from Texas and Kansas northward to North Dakota and eastward to the Atlantic Coast.

Illinois Records.—Ninety-six males, 107 females and 2 nymphs, taken May 24 to Oct. 2, are from Antioch, Chicago, De Soto, Dubois, Elizabeth, Elizabethtown, Evanston, Gibsonia, Glen Ellyn, Golconda, Harrisburg, Havana, Iroquois, Kappa, Keithsburg, Monticello, Mound City, Normal, Oregon, Pinkstaff, Quincy, St. Joseph, Savanna, Shawneetown, Starved Rock State Park, Ullin, Urbana.

Neoborus glaber Knight

Neoborus glaber Knight (1923*d*, p. 563).

MALE.—Length 4.60, width 1.90. Pronotum grabrous, shining, coarsely punctate, lateral margins sharply defined, but not prominently carinate; yellowish testaceous with a large, flaring, dark brown ray extending from each callus to posterior margin. Hemelytra with emboliar margin slightly sinuate, widest behind middle; very dark brown to piceous, shining, coarsely and rather closely punctate, glabrous or with only a minute hair set in pit of coarse punctures;

area at base of corium and embolium, and areas extending for a space along radius, yellowish testaceous; cuneus yellowish translucent, apical half and area extending along inner margin to basal angle, fusco-brownish. Membrane and veins uniformly fuscous, a small pale spot bordering apex of cuneus. Legs pale yellowish; femora with two subapical brownish bands, these bands lacking on front pair. Venter yellowish, two subdorsal lateral lines dark brownish, genital segment brownish; fine, pale pubescence present on venter, hairs more prominent on genital segment.

FEMALE.—Length 4.80, width 2.20. More robust than male and usually with pale areas broader; basal half of corium and more than basal half of cuneus yellowish.

FOOD PLANT.—White ash (*Fraxinus americana*); often found associated with *amoenus* (Reuter). A single Illinois specimen was taken on hickory (*Carya* sp.).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Michigan, Minnesota, New York, North Dakota, Ohio, Ontario, South Dakota.

Illinois Records.—NORTHERN ILLINOIS: 1 ♂. CHAMPAIGN: June 9, 1888, at light, C. A. Hart, 1 ♂. FRANKFORT: June 8, 1933, Mohr & Townsend, 2 ♂, 11 ♀. OQUAWKA: June 13, 1932, on *Carya* sp., H. L. Dozier, 1 ♀. RAGO: May 6, 1932, swamp, H. L. Dozier, 1 ♂. URBANA: May 16, 1887, C. A. Hart, 1 ♂.

Neoborus palmeri Reuter

Neoborus amoenus palmeri Reuter *in* Van Duzee (1908, p. 112).

ADULTS.—Length 5.70, width 2.40. General color pale yellowish with a brown shellaclike gloss; each callus with a transverse mark; line along lateral margin of pronotal disk, and usually a second one parallel to it, line along outer margin of radius which widens apically and crosses corium to inner angle of cuneus, fuscous to black; in pale specimens, black color showing only on corium; sides of pleura frequently black; apex of second antennal segment and entire third and fourth segments fuscous to black.

FOOD PLANT.—White ash (*Fraxinus americana*) and probably other ash trees.

KNOWN DISTRIBUTION.—Illinois, Minnesota, New York, South Dakota.

Illinois Records. — BEVERLY HILLS: Aug. 2, 1920, W. J. Gerhard, 1 ♂, FM. ELIZABETH: July 7, 1917, 1 ♂. FREEPORT: July 4, 1917, 1 ♀.

Neoborus pubescens Knight

Neoborus pubescens Knight (1917*c*, p. 81).

ADULTS.—Length 4.60, width 1.70. General color very dark brown marked with pale; clothed with prominent, erect pubescence; more coarsely punctured than in *amoenus* (Reuter). Pronotum, lateral margins distinctly carinate only on anterior half; black with top of collar, rather wide median stripe on disk, one and sometimes two rays behind each callus, pale yellow. Scutellum yellow, black at middle of base; mesoscutum black; sternum and pleura black; ostiolar peritreme pale; hemelytra pale; inner half of clavus, area along claval suture, large apical spot on corium and small area at edge of embolium, black; membrane mostly pale; in female, dark fuscous to black within cells and on areas margining veins; in male, dark fuscous extending to include middle of membrane; venter black, sometimes less dark in female.

FOOD PLANT.—White ash (*Fraxinus americana*); found developing only on young plants growing in the shade.

KNOWN DISTRIBUTION.—Illinois, Massachusetts, Michigan, New Hampshire, New York, Ohio, Ontario, Pennsylvania, Quebec.

Illinois Record.—PALOS PARK: July 4, 1910, W. J. Gerhard, 1 ♂, FM.

Neoborus canadensis (Van Duzee)

Tropidosteptes canadensis Van Duzee (1912, p. 486).

MALE.—Length 4.70, width 2.00. Head width 1.08, vertex 0.41. Antennae with first segment black; second fusco-brownish, more nearly black at base, pubescence dusky, cylindrical, constricted at base, nearly attaining the thickness of first segment; third fuscous; fourth fuscous. General color yellowish testaceous; clavus, apical area of corium, two subapical bands on hind femora, and calli, very dark brown; pronotal disk obscure brownish to fuscous on either side of median line; base of scutellum at middle brownish, brown color somewhat notched by paler on median line; dorsum coarsely and rather closely punctate, clothed with erect, yellowish pubescence.

FEMALE.—Length 5.30, width 2.40; more

robust than male; dark color more brownish than black.

FOOD PLANT.—White ash (*Fraxinus americana*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Michigan, Minnesota, Ohio, Pennsylvania, Quebec, South Dakota, Texas.

Illinois Records.—NORTHERN ILLINOIS: June, 3 ♀. FRANKFORT: June 8, 1933, on *Fraxinus* sp., Mohr & Townsend, 7 ♂, 35 ♀. PALOS PARK: June 19, 1909, A. B. Wolcott, 1 ♂, FM. ROCKFORD: June 11, 1933, Mohr & Townsend, 1 ♀. URBANA: June 1, 1889, 1 ♂, 1 ♀.

Neoborus populi Knight

Neoborus populi Knight (1929*c*, p. 4).

MALE.—Length 4.20, width 1.70. Head yellowish; tylus, spot above each antennal socket, and mark either side of median line of frons, black. Rostrum, length 1.06, nearly attaining hind margin of sternum, yellowish, apex black. Antennae with first and second segments black, third brownish, fourth yellowish. Calli prominent, black, surrounded by yellowish, posterior half of disk black, but this not joined with black on calli; lateral margins of disk slightly sinuate, not distinctly carinate. Body clothed with prominent, erect, pale pubescence, hairs longer and more prominent than in *pubescens* Knight. General color pale to yellowish, shaded with black; scutellum yellow, without vitta; calli, mesoscutum, inner apical half of clavus, all except apex of embolium, outer margin of corium exterior to radial vein, line extending across apical area of corium to inner angles, pleura, and sternum, black. Cuneus clear; membrane and veins very dark, almost black. Legs yellowish, apical halves of hind femora and bases of tibiae becoming almost black.

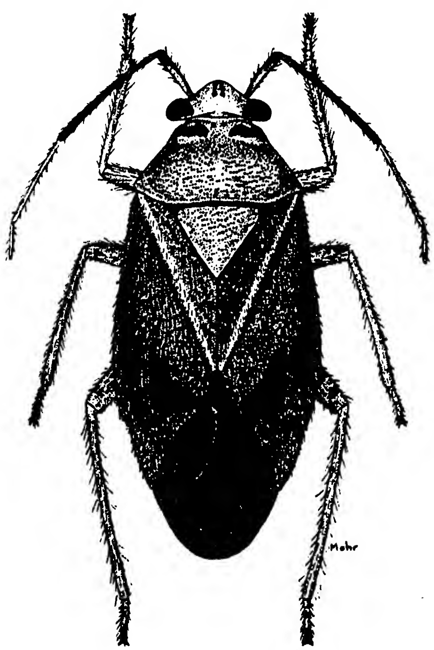


Fig. 156.—*Neoborus populi*, ♀.

FEMALE.—Fig. 156. Length 4.60, width 1.90. Very similar to male in pubescence and coloration, except black areas somewhat reduced; hind femora each with two incomplete, subapical black annuli; membrane fuscous to almost black.

FOOD PLANT.—Cottonwood (*Populus* sp.).

KNOWN DISTRIBUTION.—Illinois.

Illinois Records.—ILLINOIS: 1 ♂, 3 ♀. GALESBURG: July 16, 1892, 2 ♂, 2 ♀. URBANA, BROWNFIELD WOODS: July 19, 1926, Vera G. Smith, 1 ♂, 1 ♀, KC; July 28, 1889, C. A. Hart, 1 ♀.

Neoborus vittiscutis Knight

Neoborus vittiscutis Knight (1923*d*, p. 566).

MALE.—Length 4.00, width 1.86. Head almost black; bucculae, and margins of juga and lora, paler. Rostrum, length 1.16, reaching to middle of intermediate coxae, pale, apex black; antennae pale except second segment, which is reddish or dusky apically. Pronotum coarsely punctate, with an erect, pale hair arising from each puncture; black, shining, spot on median line, an indistinct ray behind each callus, and carinate lateral margin, pale. Scutellum pale with a narrow, black area at base and a median black line, median line more slender apically; mesoscutum black, clothed with pale pubescence; sternum and pleura black. Hemelytra with emboliar margins slightly sinuate; black, shining, coarsely punctate, slightly paler and somewhat translucent along claval veins at a spot near base of corium; cuneus pale translucent, apex with a narrow fuscous area. Membrane uniformly fuscous, scarcely paler near apex of cuneus. Legs uniformly pale.

FEMALE.—Length 5.00, width 2.30. Antennae pale. Pronotal disk yellowish testaceous with a black line bordering lateral carina and an indistinct, fuscous line be-

hind outer margin of callus. Scutellum colored similarly to that of male, median black line broader near base. Hemelytra pale testaceous with embolium and outer margin of corium exterior to radial vein black and tip of embolium pale; membrane pale, areoles except small spot near basal angle of cuneus, veins, and area bordering areoles, dark fuscous. More robust than male and with pale areas broader.

FOOD PLANT.—Ash (*Fraxinus* sp.).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Maryland, Mississippi, Missouri, Virginia.

Illinois Records.—DARWIN: July 23, 1932, on *Fraxinus americana*, Dozier & Park, 1 ♀. ELIZABETHTOWN: June 22-24, 1932, on *Fraxinus americana,* Ross, Dozier & Park, 1 ♂, 2 ♀. HARDIN: June 5-9, 1932, on *Fraxinus americana,* H. L. Dozier, 5 ♂, 3 ♀. HARRISBURG: June 25, 1932, on *Fraxinus americana,* Ross, Dozier & Park, 1 ♀. KARNAK: June 23, 1932, on *Fraxinus americana,* Ross, Dozier & Park, 2 ♀. LILLY: June 11, 1914, Mackinaw River, 1 ♂, 1 ♀. WILLOW SPRINGS: June 27, 1909, A. B. Wolcott, 1 ♂, FM.

Neoborus tricolor (Van Duzee)

Tropidosteptes tricolor Van Duzee (1912, p. 487).

ADULTS.—Length 5.70, width 2.80. Antennae pale, second segment pale with apex fuscous. Dorsum rather coarsely punctured, with an erect, prominent, pale hair arising from each puncture. General color black with rostrum except apex, legs, ostiolar peritreme, and cuneus, pale; front of head reddish to brownish.

KNOWN DISTRIBUTION.—Described from New Jersey, and since recognized only from Illinois, Indiana, Mississippi, Missouri.

Illinois Records.—URBANA: Aug. 9, 1920, J. R. Malloch, 1 ♂. VIENNA: June 14, 1934, DeLong & Ross, 1 ♀.

Neoborus rufusculus Knight

Neoborus rufusculus Knight (1923*d*, p. 564).

ADULTS.—Length 4.60, width 1.86. General color of head yellowish; tylus, median line of front and joining arc above, and juga except sutural margins, blackish. Antennae, first segment black; second fusco-blackish; third and fourth fuscous. Pronotum, length 0.94, width at base 1.69; coarsely and rather closely punctate, shining, clothed with erect, pale yellowish pubescence; brownish black; collar, median line of disk that narrows near basal margin, spot behind outer angle of each callus, and slender basal margin, yellowish testaceous; carinate lateral margins of disk only moderately distinct, slightly more sulcate than in *canadensis* (Van Duzee). Scutellum coarsely punctate, clothed with erect, yellowish pubescence; brownish black, median line and basal angles paler; mesoscutum brownish with prominent pubescence. Sternum brownish black, median line yellowish, pleura blackish, clothed with prominent pubescence; ostiolar peritreme pale. Hemelytra, emboliar margins nearly straight, but curved at each end; reddish brown, translucent, darker on clavus bordering scutellum and commissure; rather coarsely and closely punctate, shining, clothed with prominent, erect, yellowish pubescence; cuneus reddish brown, translucent, scarcely paler at base. Membrane and veins fusco-brownish, a small pale spot bordering apex of cuneus. Legs yellowish; apical half of hind femora, somewhat on apex of middle pair, base of tibiae and somewhat on middle of hind pair, blackish; apices of tarsi fuscous. Venter blackish; ventral surface except on genital segment, yellowish; pubescence pale.

FOOD PLANT.—Ash (*Fraxinus americana*).

KNOWN DISTRIBUTION.—Illinois, Minnesota, Mississippi, New York, Texas.

Illinois Record.—WHITE PINES FOREST STATE PARK: June 4, 1933, Ross & Townsend, 1 ♂.

Xenoborus Reuter

KEY TO SPECIES

1. Membrane pale or, if fuscous, paler on middle 2
   Membrane uniformly fuscous or black . 3
2. Dorsum uniformly pale greenish yellow, fuscous along commissure of hemelytra; length 6.40.............................**commissuralis**, p. 144
   Dorsum with black areas broader; calli, spot either side of median line on pronotal disk, clavus except along claval vein, and spot on apical area of corium, very dark fuscous, almost black; membrane fuscous, with an oval spot on middle of apical half;

within areoles, distinctly paler; length 5.00........... **plagifer,** p. 144

3. Posterior tibiae uniformly pale; femora pale or only rarely dusky near apex; embolium and basal half of corium pale in both sexes... **neglectus,** p. 144

   Posterior tibiae fuscous, almost black near base; posterior femora black apically or with dark color forming two bands; embolium and basal half of corium pale in some female specimens................ **pettiti,** p. 145

Xenoborus commissuralis Reuter

Xenoborus commissuralis Reuter *in* Van Duzee (1908, p. 112).

ADULTS.—Length 6.40, width 2.30. General color uniformly pale greenish, becoming yellowish after death; antennae, a narrow streak along commissure of hemelytra, tips of tarsi, and tip of rostrum, very dark fuscous, almost black; membrane pale translucent; brachium and a streak beyond apex of larger areole dusky.

FOOD PLANT.—Black ash (*Fraxinus nigra*); occurs during July and August.

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, New York, Nova Scotia, Ontario, Quebec.

Illinois Records.—NORTHERN ILLINOIS: 1 ♂, 4 ♀. GALESBURG: July 16, 1892, 2 ♀.

Xenoborus plagifer (Reuter)

Tropidosteptes plagifer Reuter (1909, p. 51).

ADULTS.—Length 5.00, width 1.90. General color pale yellowish testaceous; antennae, calli, male usually with a spot either side of median line on pronotal disk, clavus except claval vein, and spot on apical area of corium, very dark brown, almost black; scutellum yellow; membrane fuscous, with an oval spot on middle of apical half, and area within areoles, distinctly paler; female with pale areas broader, infuscation on apical half of membrane forming a ray at either side behind areoles. Male claspers as in fig. 157.

FOOD PLANT.—Black ash (*Fraxinus nigra*); occurs during August and September.

KNOWN DISTRIBUTION.—Illinois, Minnesota, New York, Ontario, Wisconsin.

Illinois Records.—NORTHERN ILLINOIS: 2 ♂, 6 ♀. GALESBURG: Sept. 12, 1888, 2 ♂, 2 ♀.

Xenoborus neglectus Knight

Xenoborus neglectus Knight (1917*c*, p. 82).

MALE.—Length 5.40, width 2.10. General color black with pale areas; antennae almost black, paler on base of first segment; head with lower half of face fuscous; front pale, flecked with reddish; carina and a small median dash at middle of vertex almost black. Pronotum not carinate, punctation and pubescence nearly as in *plagifer* (Reuter); collar and large median spot or ray on disk white or pale yellow; pale ray extending from outer angle of callus

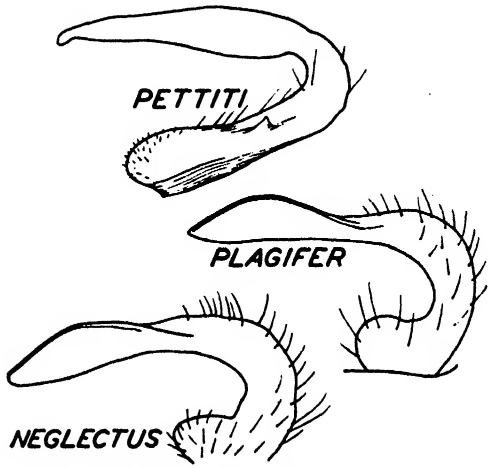


Fig. 157.—Male left genital claspers of *Xenoborus*.

along lateral margin of disk to basal angle: scutellum pale yellowish, mesocutum almost black. Hemelytra very dark brown, almost black; embolium, basal angle of corium and cuneus, pale translucent; membrane uniformly fuscous. Legs pale yellowish; hind femora sometimes dusky near apices, but never distinctly banded. Claspers as in fig. 157.

FEMALE.—Membrane slightly paler on middle; a black ray present behind each callus; lateral margin and basal angle of disk remaining yellowish.

FOOD PLANTS.—Occurs during June and probably breeds on black ash (*Fraxinus nigra*). Found on pignut (*Carya glabra*) in Illinois.

KNOWN DISTRIBUTION.—Illinois, Michigan, New York, Ohio, Ontario.

Illinois Record.—EAST DUBUQUE: June 1, 1933, on *Carya glabra,* Ross & Townsend, 2 ♂, 8 ♀.

Xenoborus pettiti (Reuter)

Tropidosteptes pettiti Reuter (1909, p. 50).

ADULTS.—Length 5.70, width 2.10. General color black; scutellum yellow; sometimes with embolium, basal half of corium, and all of cuneus except apex, pale; front of head and pronotal disk sometimes reddish; lateral margins and basal angles of disk never so pale as median line, except in teneral specimens killed before any black color develops on pronotum; legs pale, with posterior femora almost black apically, or with dark color forming two subapical bands. Male claspers as in fig. 157.

FOOD PLANT.—White ash (*Fraxinus americana*); occurs during May and June.

KNOWN DISTRIBUTION.—Iowa, Kansas, Minnesota and eastward.

Illinois Records.—NORTHERN ILLINOIS: 1 ♂. ALGONQUIN: June 12, 1897, 1 ♀; June 29, 1907, W. A. Nason, 1 ♂, 1 ♀. CHICAGO: June 5, 1908, at light, W. J. Gerhard, 1 ♂, FM. FRANKFORT: June 8, 1933, Mohr & Townsend, 4 ♀. PALOS PARK: June 20, 1909, at light, W. J. Gerhard, 4 ♂, FM. URBANA: May 19, 1889, C. A. Hart, 1 ♂; May 31, 1889, C. A. Hart, 1 ♀. WHITE PINES FOREST STATE PARK: June 4, 1933, Ross & Townsend, 1 ♀.

Lygidea Reuter

KEY TO SPECIES

1. Rostrum scarcely attaining posterior margin of intermediate coxae...... 2
   Rostrum reaching to near apices of hind coxae.......................... 4
2. Length of first antennal segment equal to width of vertex plus one-half dorsal width of an eye; hemelytra with pubescence chiefly suberect, set moderately close; cuneus chiefly pale, red only along inner margin and at apex................**viburni**, p. 145
   Length of first antennal segment less than or scarcely greater than width of vertex...................... 3
3. Second antennal segment provided with several erect hairs that in length exceed thickness of segment; length 6.00–6.30............**rosacea**, p. 145
   Second antennal segment provided only with short hairs that in length are less than thickness of segment; length 5.60–5.90.......**salicis**, p. 146
4. Color orange red with basal margin of pronotum and variable areas of outer margins of hemelytra fuscous to almost black.......**mendax**, p. 146
   Color chiefly fuscous to almost black with ground color pale to greenish, never reddish........**obscura**, p. 145

Lygidea rosacea Reuter

Lygidea rubecula rosacea Reuter (1909, p. 46).

MALE.—Length 6.70, width 2.00. Head width 1.26, vertex 0.63. Rostrum, length 1.85, reaching to middle of intermediate coxae. Antennae, first segment, length 0.60; second, 2.10, pubescence dense and intermixed with several erect hairs which in length exceed thickness of segment; third, 0.88; fourth, 0.57. Hemelytra densely clothed with closely appressed, golden yellow pubescence; clavus and apical half of corium fuscous to black, basal half of corium and embolium yellowish translucent. Cuneus red with a yellowish area at base and extending to middle along outer margin.

FEMALE.—Length 6.50, width 2.60. Head width 1.34, vertex 0.68. Antennae, first segment, length 0.60; second, 1.90; third, 0.80; fourth, 0.60. Dorsum chiefly red, although in dark forms clavus and apical half of corium becoming infuscated.

FOOD PLANT.—Sandbar willow (*Salix longifolia*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, Ohio, South Dakota.

Illinois Records.—Fifteen males and 32 females, taken June 1 to July 7, are from Champaign, Chicago, Elizabethtown, Freeport, Grand Tower, Grayslake, Iroquois, Kampsville, Keithsburg, New Milford, Pike, Prophetstown, Savanna, Urbana, Vienna, Willow Springs.

Lygidea viburni Knight

Lygidea viburni Knight (1923*d*, p. 569).

No Illinois specimens; known from Massachusetts, New Hampshire, New York. Breeds on nannyberry (*Viburnum lentago*).

Lygidea obscura Reuter

Lygidea rubecula obscura Reuter (1909, p. 46).

MALE.—Length 6.00, width 2.20. Smaller and darker colored than *rubecula* (Uhler).

General color dark fuscous to black with genae, apices of juga, median line on frons, median line and slender area along basal margin of pronotum, lateral margins and apical two-thirds of median line of scutellum, thoracic sternum, and lower half of abdominal venter except on genital segment, coxae, basal halves of femora, and tibiae except base and apex, pale to yellowish; cuneus pale translucent, inner half reddish, apex dark red to almost black.

FEMALE.—Length 6.00, width 2.40; very similar to male, but with dark areas smaller. General color yellowish to brownish, darkened with fuscous; head yellowish with bases of juga, and broad mark on frons either side of median line, black; pronotum brownish, a broad black line at either lateral margin and a black ray behind callus on either side of pale median line; hemelytra rather uniformly fusco-brownish; hind femora with very dark brown bands before apices, anterior face more or less black on apical half.

FOOD PLANT.—Black willow (*Salix nigra*).

KNOWN DISTRIBUTION.—Illinois, Michigan, New York, Nova Scotia, Ontario, Pennsylvania.

Illinois Records.—Eleven males and 11 females, taken June 3 to July 5, are from Champaign, Chicago, Grand Detour, Homer, Kampsville, Keithsburg, Mount Carmel, Rockford, Urbana, Warsaw, White Heath.

Lygidea salicis Knight

Lygidea salicis Knight (1939*a*, p. 22).

MALE.—Length 5.60, width 2.20. Rostrum pale, apex black. Antennae with first segment black, slender apex pale; second fusco-brownish, basal one-fourth black, pubescence rather short and recumbent; third fuscous; fourth almost black. Pronotum with disk punctate, transversely rugulose; black, collar except behind eyes, median line of disk, two blotches behind outer halves of calli, disks of calli, narrow area along basal margin, and dorsal margin, pale; ventral one-third of propleura pale. Scutellum pale with a wedge-shaped, very dark brown mark on either side of median line, mesoscutum black. Hemelytra very dark brown, embolium except apically, cuneus except reddish spot on apex, pale translucent. Membrane uniformly dark fuscous, less dark on area bordering apex of cuneus; veins pale. Clavus and corium clothed with pale to silvery, somewhat silky pubescence. Ventral surface white to yellowish; a broad, lateral, longitudinal stripe on thoracic pleura and sides of venter, reddish brown to black. Legs pale; hind femora with two subapical reddish brown annuli; tibial spines yellowish; apical segment of each tarsus fuscous.

FEMALE.—Length 5.90, width 2.30. Very similar to male in color and pubescence, but pale area on disk of pronotum broader.

FOOD PLANT.—Peach-leaved willow (*Salix amygdaloides*).

KNOWN DISTRIBUTION.—Illinois, Michigan, Minnesota, Ontario.

Illinois Record.—GALENA: June 30, 1932, Dozier & Mohr, 1 ♂, 1 ♀.

Lygidea mendax Reuter

Apple Redbug, fig. 158.

Lygidea mendax Reuter (1909, p. 47).

While not as yet collected in Illinois, this bright, orange red species undoubtedly will be found along the Rock River and vicinity.

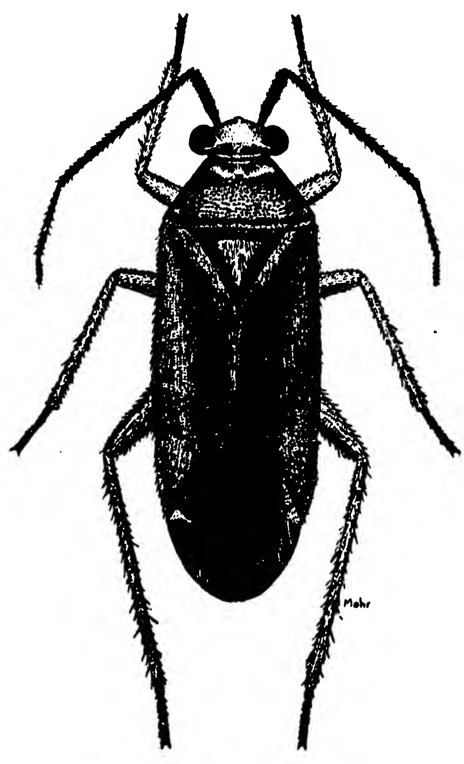


Fig. 158.—*Lygidea mendax*, ♀.

This assumption is based on the fact that *mendax* has been collected near Davenport and Bentonsport, Iowa. Occurs on hawthorn (*Crataegus* sp.), American crabapple (*Pyrus coronaria*), cultivated apple (*Pyrus malus*) and to some extent on cultivated quince (*Cydonia oblonga*). This insect is now regarded as a serious pest on apples in New York, Pennsylvania and Michigan. Known from Connecticut, Indiana, Iowa, Maine, Michigan, New York, Nova Scotia, Ohio, Ontario, Pennsylvania.

Neocapsus Distant

Neocapsus cuneatus Distant

Neocapsus cuneatus Distant (1893, p. 438).

MALE.—Length 4.80, width 2.60. Head width 1.17, vertex 0.52. Rostrum, length 1.73, reaching to apices of middle coxae.

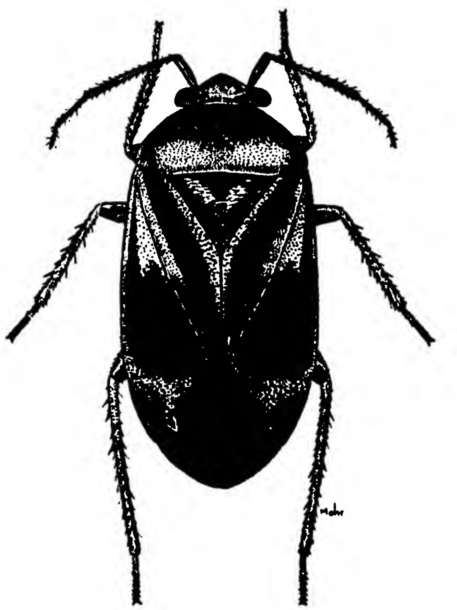


Fig. 159.— *Neocapsus cuneatus*, ♀.

Antennae very short, black, with fine pubescence; first segment, length 0.47; second 1.38, cylindrical, slightly more slender near base; third, 0.56; fourth, 0.35. Pronotum, length 1.25, width at base 2.25; finely, shallowly punctate. Scutellum transversely rugulose, orange red, rarely partly black. Dorsum practically glabrous; hemelytra with minute pubescence in some of the shallow punctures. General color black; pronotum, except calli and basal angles, femora, and sometimes cuneus, red; head yellowish to red; tylus usually darker.

FEMALE.—Fig. 159. Length 5.60, width 2.80. More robust than male and usually with red areas broader; pronotum, scutellum, cuneus, femora and ventral surface of body orange to red; basal area of corium usually pale; tibiae and second antennal segment largely pale.

FOOD PLANT.—Post oak (*Quercus stellata*), according to Dr. H. G. Johnston.

KNOWN DISTRIBUTION. — Arizona, Illinois, Mississippi, Missouri, North Carolina, Oklahoma, Texas; Mexico.

Illinois Records.—DUBOIS: May 15, 1917, 1 ♂; May 22, 1917, 1 ♂; May 23, 1917, 2 ♂, 7 ♀; May 24, 1917, 4 ♂, 3 ♀.

Platylygus Van Duzee

Platylygus luridus (Reuter)

Lygidea rubecula var. *lurida* Reuter (1909, p. 46).

MALE.—Fig. 160. Length 6.50, width 2.40. Minutely pubescent; dorsum practi-

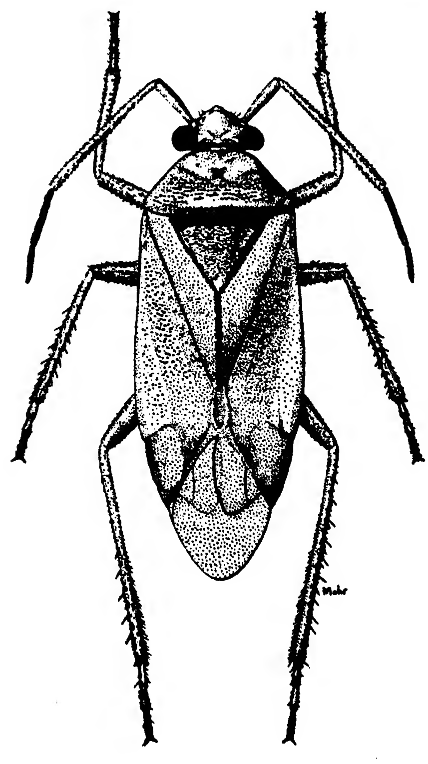


Fig. 160.—*Platylygus luridus*, ♂.

cally glabrous. General color pale yellowish brown; hemelytra translucent; collar and tip of scutellum pale to white; apex and inner half of cuneus, brachium, disk of scutellum, apices of femora, and area on venter, somewhat reddish; third and fourth antennal segments infuscated; apex of rostrum piceous; membrane fumate or pale brownish.

FEMALE.—Length 7.00, width 2.70; more robust than male, but otherwise very similar in structure and coloration.

FOOD PLANT.—White pine (*Pinus strobus*). The nymphs are yellowish with a tinge of brownish, and thus very closely match the color of the bud scales of their host plant.

KNOWN DISTRIBUTION.—Illinois, New Hampshire, New York.

Illinois Record.—NORTHERN ILLINOIS: 1 ♀.

Lygus Hahn

KEY TO SPECIES

1. Length of second antennal segment less than width of head; body ovate, robust, yellowish brown to dark reddish brown, darkened with fuscous........**rubicundus**, p. 153
   Length of second antennal segment greater than width of head........ 2
2. Basal carina of vertex lacking in middle, visible only at corners of eyes; green or greenish yellow, preserved specimens fading to dull yellowish; Y-shaped fuscous mark formed by anal areas of membranes; usually with a longitudinal cloud distad of areoles..........**pabulinus**, p. 153
   Basal carina of vertex entire; variously colored...................... 3
3. Rostrum just attaining posterior margins of middle coxae; scutellum bright yellow or green...............................**campestris**, p. 154
   Rostrum reaching to or slightly beyond hind coxae................ 4
4. Hind tibiae deep black...............................**atritibialis**, p. 152
   Hind tibiae more or less pale........ 5
5. Color chiefly pale or green, sometimes with darker markings........... 6
   Color yellowish brown to black, or reddish......................... 8
6. Tibiae uniformly pale greenish, without bands at base; eyes large; color of body chiefly green..**apicalis**, p. 154
   Tibiae spotted, often with red and black bands at base.............. 7
7. Rostrum almost, but not quite, reaching tips of hind coxae; abdomen uniformly green; area along claval vein and spot on apical area of corium fuscous..............**elisus**, p. 152
   Rostrum attaining or slightly exceeding apices of hind coxae; abdomen marked with black; hemelytra of female uniformly pale, of male darkened with red and black.......................**hesperus**, p. 151
8. Hemelytra black and irregularly mottled with greenish yellow; head and anterior part of pronotum yellowish green, usually with two black rays behind each callus..................................**plagiatus**, p. 153
   Hemelytra sometimes dark but not mottled with pale spots; head and pronotum not colored as above.... 9
9. Length 6.50–7.30; nearly glabrous, strongly shining..**vanduzeei**, p. 150
   Length 4.80–6.30; distinctly pubescent...........................10
10. Second antennal segment three times as long as first segment; frons uniformly yellowish, without black lines; length 6.00–6.30..**frisoni**, p. 151
    Second antennal segment less than three times as long as first segment; frons with median line dark; length 5.00–5.50.......**oblineatus**, p. 148

Lygus oblineatus (Say)

Tarnished Plant Bug

Capsus oblineatus Say (1832, p. 21).

This species has passed in American literature under the name *Lygus pratensis* (Linnaeus) for many years. It differs, however, from the European *pratensis* in the structure of the right genital clasper, fig. 161; *oblineatus* is darker in color and has definite stripes.

ADULTS.—Fig. 162. Length 4.90–5.50, width 2.50; ovate. General color shining, yellowish brown with more or less blackish marking, or reddish brown and fuscous areas; pronotum with yellowish and blackish rays; scutellum margined with blackish leaving a Y- or heart-shaped yellowish

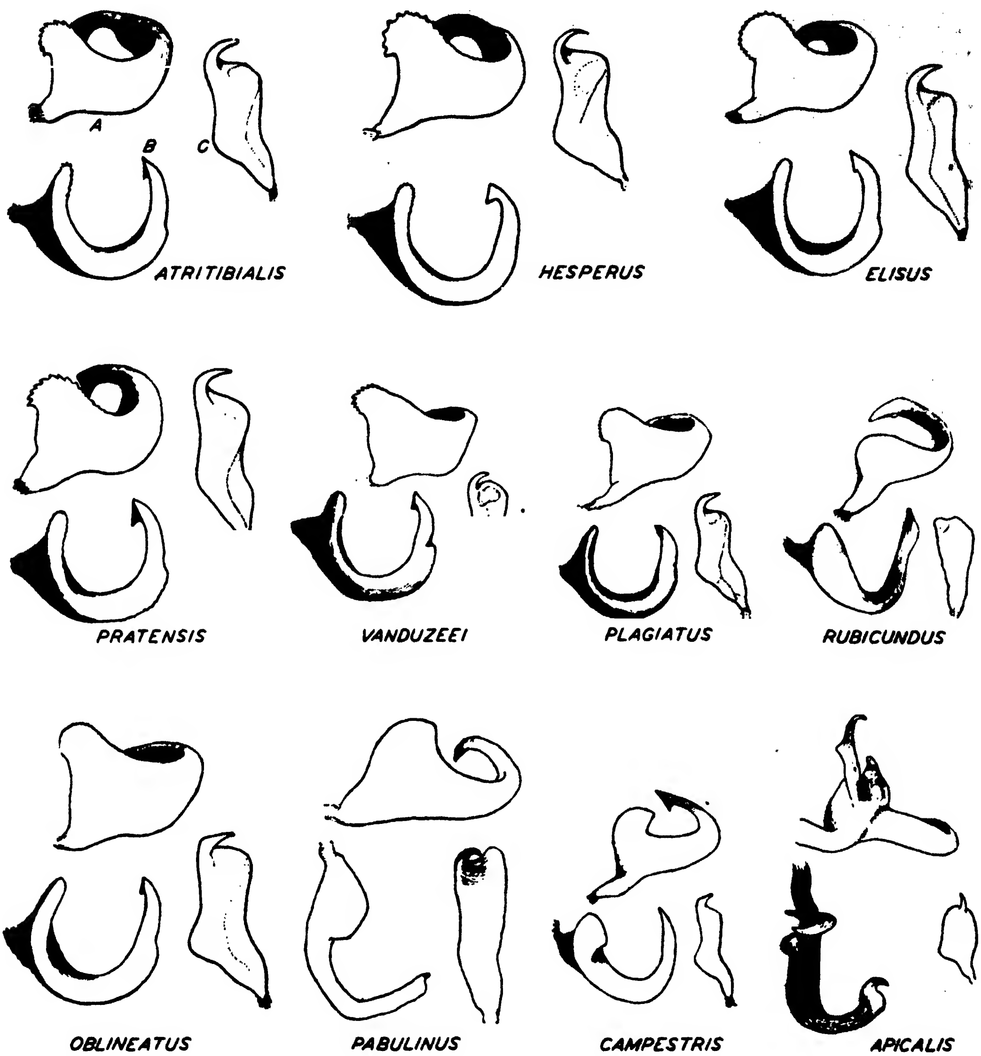


Fig. 161.—Male genital claspers of *Lygus*. *A*, left clasper, lateral aspect; *B*, left clasper, dorsal aspect; *C*, right clasper, mesal aspect.

central area; hemelytra reddish brown or blackish, streaked with yellowish or gray. The amount of black on the dorsum varies greatly.

The very dark extremes in which the black predominates belong to the variety *strigulatus* (Walker) (1873, p. 94). Both extremes and their intergrades have been collected together throughout Illinois.

KNOWN DISTRIBUTION.—This is the commonest species of the family Miridae in the eastern United States and is found everywhere frequenting many kinds of plants. It is a pest on nursery stock, ornamental plants and cultivated crops. The adults hibernate chiefly under leaves on the ground; many also hibernate in mullein rosettes.

Illinois Records.—Five hundred eighty-five males and 453 females, taken Jan. 24 to Nov. 13, are from Albion, Algonquin, Allerton, Alton, Alto Pass, Amboy, Antioch, Apple River Canyon State Park, Auburn Park, Beach, Beardstown, Beverly Hills, Bloomington, Bluff Springs, Borton, Browns, Bureau, Cache, Calvin, Carbondale, Carthage, Cary, Champaign, Charleston, Chester, Chicago, Custer Park, Cypress, Danville, Darwin, Decatur, Delavan, De Soto, Dixon, Dolson, Dubois, East Cape Girardeau, East Dubuque, Effingham, Ei-

chorn, Elizabeth, Elizabethtown, Erie, Ernst, Evanston, Fairmount, Farmer City, Fountain Bluff, Fox Lake, Frankfort, Fulton, Galena, Galesburg, Georgetown, Giant City State Park, Glencoe, Glen Ellyn, Glenview, Golconda, Grand Detour, Grand

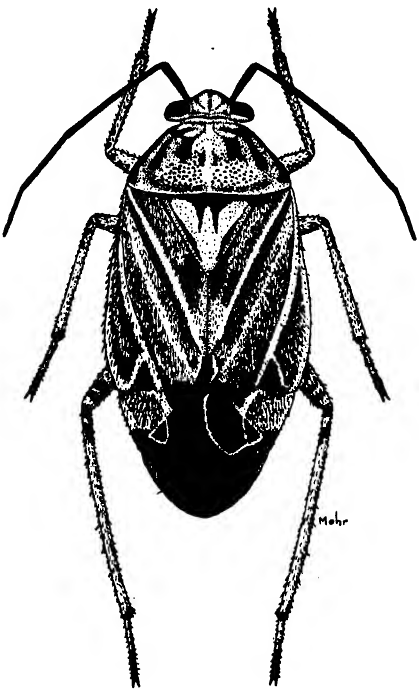


Fig. 162.—*Lygus oblineatus.*

Tower, Grand View, Grayville, Hamilton, Hardin, Harrisburg, Harvard, Hatton, Havana, Henry, Herod, Hillsboro, Hillsdale, Homer, Horseshoe Lake, Iroquois, Joliet, Kampsville, Kankakee, Kansas, Kappa, Karnak, Keithsburg, Lawrenceville, Lima, Litchfield, Mahomet, Makanda, Marshall, Mason City, Maywood, McClure, Metropolis, Milford, Monmouth, Monticello, Mounds, Mount Carmel, Mount Carroll, Muncie, New Columbia, New Milford, Normal, Oak Lawn, Oakwood, Olive Branch, Ozark, Palmer, Palos Park, Paris, Parker, Patoka, Pekin, Philadelphia, Pulaski, Quincy, Riverdale, River Forest, Rockford, Rock Island, Rockton, St. Anne, Savanna, Savoy, Seymour, Shawneetown, Sheldon, Sherman, Sparland, Springfield, Starved Rock State Park, Temple Hill, Union County State Forest, Urbana, Vienna, Ware, Warsaw, Watseka, Waukegan, West Union, White Heath, White Pines Forest State Park, Willow Springs, Woodstock, York, Zion.

Lygus vanduzeei Knight

Lygus vanduzeei Knight (1917*b*, p. 565).

MALE.—Length 7.10, width 3.30. Head width 1.25, vertex 0.50. Rostrum, length 2.93, just attaining posterior margins of hind coxae, yellowish brown, apex blackish. Antennae, first segment, length 0.85, reddish brown to black; second, 2.22, reddish brown, apex blackish; third, 1.31, blackish, narrow pale area at base; fourth, 1.00, fuscous; all segments with fine pubescence. Pronotum, length 1.70, width at base 2.82; nearly glabrous, strongly shining, punctures deep and irregularly placed; a small black spot present behind each callus, usually two in darkest specimens; basal angles with a black spot just inside the narrow, pale margins; in darkest specimens, dark lines extending along lateral margins of disk; a small black spot present just above coxal cleft; dark specimens have dark brown rays behind black spots on disk. Scutellum transversely rugose and sparsely punctate; yellowish brown, with apex and dash on either side at base paler. Hemelytra strongly shining, with minute pubescence, nearly glabrous; punctures coarse and deep, somewhat crowded; color rich dark brown, darker on clavus and at apex of corium; claval vein and cubitus pale; embolium translucent yellowish except at apex; cuneus translucent yellowish, dark brownish to blackish at base and on extreme apex. Membrane fuliginous, a pale spot present in center and on either side just behind apex of cuneus; veins at apices of cells and in area bordering apex of cuneus also pale. Legs yellowish brown, apical halves of posterior femora brownish to blackish, with two pale rings near each apex; tibiae greenish yellow, each apex and spines dark brownish, a dark spot on base and, in some cases, a dark stripe; tarsi dark brownish, tips blackish. Venter yellowish brown, a dark brownish, longitudinal stripe on either side; some specimens brownish beneath, thus forming a pale stripe beneath dark lateral one. Genital claspers, fig. 161, typical for this group, but shape of claw on right clasper and internal arm on left distinguishes this species.

FEMALE.—Length 6.70; width 3.40; more robust than male, but very similar in color and general structural characters.

FOOD PLANT.—Goldenrod (*Solidago canadensis* and perhaps other species of the genus). The adults hibernate and come forth in early spring to feed on the tender goldenrod plants. The eggs are doubtless inserted in the goldenrod stems where the nymphs appear and feed during July. In New York, most of the adults mature by the middle of August, and continue to feed until the cool September nights make them seek hibernation quarters.

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, Ontario, Wyoming and eastward, perhaps everywhere its host plant grows freely.

Illinois Records.—NORTHERN ILLINOIS: 1 ♂. APPLE RIVER CANYON STATE PARK: July 11, 1934, DeLong & Ross, 1 ♂, 2 ♀. GALESBURG: Sept. 13, 1888, 1 ♀. ROCK ISLAND: May 19, 1934, Ross & Mohr, 1 ♂. SAVANNA: June 13, 1917, 1 ♀. WHITE PINES FOREST STATE PARK: July 12, 1934, DeLong & Ross, 1 ♂.

Lygus frisoni new species

This is to be distinguished from *oblineatus* (Say) by its larger size and longer second antennal segment; it is smaller than *vanduzeei* Knight, but the second antennal segment is relatively longer than in that species.

MALE.—Length 6.10, width 3.00. Head width, 1.18, vertex 0.48; yellowish without dark marks, collum black. Rostrum, length 2.60, extending to tips of hind coxae, yellowish, apex black. Antennae, first segment, length 0.73, yellowish brown, becoming blackish beneath; second, 2.20, brownish, apical one-fourth black; third, 1.04, black; fourth, 0.91, black. Pronotum, length 1.38, width at base 2.38; disk rather coarsely punctate; yellowish brown; two small spots present behind each callus, large spot at either basal angle, and ray behind top of coxal cleft, black. Scutellum pale to yellowish, darker on median line at base; coarsely punctate; transversely rugulose. Hemelytra punctate, with rather fine pubescence, this pubescence more distinct than in *vanduzeei;* pale translucent yellow; apical area of corium and area on middle of clavus fuscous to black. Cuneus pale, translucent; extreme tip black. Membrane dark fuscous, veins yellowish; marginal spot beyond tip of cuneus and basal half of cells clear. Venter very dark brown with a broad lateral, longitudinal, yellowish stripe. Legs yellowish brown; apical half of each hind femur very dark brown, with three rather irregular, pale fasciae on anterior aspect; tibiae pale; spot at base and elongate mark just beneath black. Genital claspers rather similar to those of *vanduzeei.*

Holotype, male.—Urbana, Ill.: Sept. 1932, T. H. Frison.

Paratype.—Same data as for holotype, 1 ♂.

Lygus hesperus Knight

Legume Bug

Lygus elisus hesperus Knight (1917*b*, p. 575).

MALE.—Length 6.50. Head width 1.22, vertex 0.45. Rostrum, length 2.68, slightly exceeding posterior margin of hind coxae. Antennae, first segment, length 0.65, pale reddish brown, fuscous on ventral side; second, 2.11, reddish, apex and ventral side at base very dark brown; third, 1.00, dark reddish brown to fuscous; fourth, 0.63, fuscous. Pronotum, length 1.34, width at base 2.30; yellowish; outer half of calli and a small round spot behind each inner margin, a spot within basal and anterior angles of disk, and a small spot behind coxal cleft, black. Hemelytra more pallid than yellowish; apex of clavus and suture, apical half of corium, and tip of embolium, reddish or marked with red; cuneus with inner margin and apex reddish. Membrane pale, faintly shaded with brownish in areas bordering veins, a darker mark at inner apical angles of larger areoles. Legs yellowish, more or less shaded with reddish; two annuli present near apex of each femur; tibiae yellowish, apices reddish, spines black. Venter fuscous beneath, sides yellowish. Genital claspers as in fig. 161.

FEMALE.—Length 6.40. More uniformly yellowish than male, pronotum entirely yellow except for a small black dot behind inner margin of each callus; hemelytra uniformly pallid, without reddish; markings on femora more reduced than in male; venter yellow. Rostrum attaining or slightly exceeding posterior margins of hind coxae.

FOOD PLANTS.—This species is an important pest of beans and alfalfa in Idaho and Utah and on cotton in Arizona. Shull (1933) has published a work on the biology and economic status of this species and has given it the common name "legume bug."

KNOWN DISTRIBUTION.—This is a west-

ern species that finds its eastern limits of distribution in Illinois, Iowa, Michigan and Minnesota.

Illinois Record. — NORTHERN ILLINOIS: 1 ♀.

Lygus atritibialis new species

This species is allied to *hesperus* Knight and related western species, but is easily to be distinguished by its uniformly black antennae and posterior tibiae, fig. 163.

MALE.—Length 5.40, width 2.50. Head width 1.17, vertex 0.45; yellow, collum black. Rostrum, length 2.30, extending slightly beyond hind coxae, yellow, apex very dark brown. Antennae uniformly black; first segment, length 0.52; second, 1.56; third, 0.87; fourth, 0.65. Pronotum, length 1.25, width at base 2.16; yellow; a lateral, submarginal line joining outer half of callus, two rays behind each callus (in dark specimens these rays joining to form a submarginal line), and ray behind top of coxal cleft, black. Scutellum yellow; a geminate mark on middle of base, lateral edges and mesoscutum, black. Hemelytra pale, translucent yellowish; middle of clavus and outer apical angle of corium fuscous. Cuneus pale, translucent; outer margin yellowish, but not darker on apex. Membrane pale fuscous, veins pale. Dorsum clothed with fine, short, pale pubescence. Ventral surface uniformly yellow. Legs mostly yellowish, but hind femora with two subapical black annuli; hind tibiae black; middle and front pairs pale, fuscous at apices and each one with a black ring at base, spines black; tarsi fuscous, apices and claws very dark brown. Genital claspers as in fig. 161.

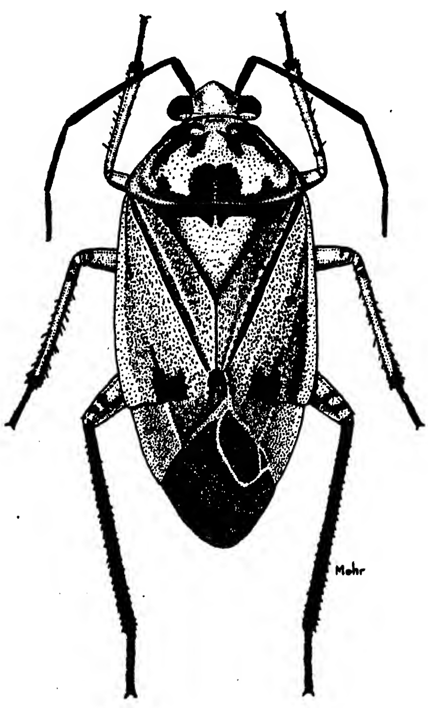


Fig. 163.—*Lygus atritibialis*, ♀.

FEMALE.—Length 5.20, width 2.50. Head width 1.17, vertex 0.52. Antennae, first segment, length 0.49; second, 1.51. Slightly more robust than male, but very similar in coloration; black marks on pronotum usually more reduced.

FOOD PLANT.—Apparently breeds on wormwood (*Artemisia canadensis*).

Holotype, male.—Oregon, Ill.: July 4, 1932, on *Artemisia canadensis,* Mohr & Dozier.

Allotype, female.—Same data as for holotype.

Paratypes.—ILLINOIS.—OREGON: Same data as for holotype, 32 ♂, 48 ♀. ROCKFORD: June 11, 1933, Mohr & Townsend, 2 ♂. ZION: July 6, 1932, T. H. Frison *et al.*, 1 ♂.

MICHIGAN.—PENTWATER: July 17, 1916, E. Liljeblad, 1 ♂.

MINNESOTA.—ST. PAUL: St. Anthony Park, June 18, 1921, at light, H. H. Knight, 1 ♀, KC.

Lygus elisus Van Duzee

Pale Legume Bug

Lygus pratensis elisus Van Duzee (1914, p. 20).

MALE.—Length 4.80–5.80. Head width 1.20, vertex 0.45. Rostrum, length 2.11, scarcely attaining posterior margins of hind coxae. Antennae, first segment, length 0.52, pale yellowish to brown, very dark brown on ventral surface; second, 1.98, dusky brown, lower side at base and extreme apex darker; third, 0.85, brownish, apex fuscous; fourth, 0.60, dusky brown. Pronotum, length 1.40, width at base 2.20; coarsely, deeply and closely punctate, with minute, pale pubescence. General color pale greenish with pronotum and scutellum bright green, a small black spot present behind each callus. Scutellum bright green, two black dashes in middle at base; roughly, transversely rugose. Mesoscutum black,

scarcely exposed. Hemelytra pale, translucent; clavus with a dusky cloud in middle, divided by pale claval vein; apex of corium with two small, fuscous patches; cuneus pale, extreme tip fuscous; membrane clear, veins pale. Legs pale yellowish; femora with a wide, fuscous band in middle on ventral side, also with two annuli near each apex; tibiae with a spot on knee and a ring just below, fuscous; spines very dark brown. Venter yellowish green; genital claspers distinctive, fig. 161.

FOOD PLANTS.—This species is an important pest on beans and alfalfa in Idaho, Utah and Arizona and perhaps other western states. Shull (1933) has discussed the biological and economic status of this species and has given it the common name "pale legume bug."

KNOWN DISTRIBUTION.—This is a western species which migrated eastward during the drought years of 1930 to 1936. It is now known from Illinois, Iowa, Minnesota and all the states westward.

Illinois Record.—ILLINOIS: 1 ♀.

Lygus plagiatus Uhler

Lygus plagiatus Uhler (1895, p. 35).

MALE.—Length 5.30, width 2.80. More robust than *oblineatus* (Say). General color black with greenish yellow mottling; head and anterior part of pronotum yellowish or olive green, hemelytra irregularly mottled with black and less dark spots. Right genital clasper distinctive, fig. 161.

FEMALE.—Slightly more robust than male and usually not so dark in color; second antennal segment shorter; pronotum yellowish, black rays behind calli frequently not reaching black basal margin; venter greenish yellow, blackish on the vagina exterior, dark specimens with black more extended.

FOOD PLANTS.—Giant ragweed (*Ambrosia trifida*); a few Illinois specimens were collected on fleabane (*Erigeron* sp.), smartweed (*Polygonum* sp.), willow (*Salix* sp.) and hickory (*Carya glabra*). The last is undoubtedly a "sitting" record.

Illinois Records.—One hundred thirty-one males and 107 females, taken Feb. 12 to Dec. 1, are from Algonquin, Allerton, Alton, Anna, Antioch, Apple River Canyon State Park, Ashley, Beardstown, Bloomington, Borton, Browns, Calvin, Carbondale, Champaign, Charleston, Danville, Darwin, Decatur, De Soto, Dubois, East Dubuque, East St. Louis, Elizabeth, Elizabethtown, Forest City, Fountain Bluff, Freeport, Galena, Galesburg, Grand Tower, Harvard, Havana, Hillsboro, Hillsdale, Homer Park, Kansas, Kappa, Keithsburg, Lawrenceville, Mahomet, Monticello, Mounds, Muncie, Murphysboro, Niota, Oakwood, Oquawka, Oregon, Palos Park, Parker, Pekin, Philadelphia, Prophetstown, Quincy, Rock Island, Rockford, Rockton, St. Francisville, St. Joseph, Sherman, Starved Rock State Park, Springfield, Urbana, Warsaw, Waukegan, West Pullman, White Heath, White Pines Forest State Park, Willow Springs, York.

Lygus rubicundus (Fallen)

Phytocoris rubicundus Fallen (1829, p. 92).

MALE.—Length 4.50, width 2.14. Ovate, robust. General color dark reddish brown to fuscous; second antennal segment shorter than width of head; genital claspers distinctive for species, fig. 161.

FEMALE.—Very similar to male in structure, but usually not so darkly colored.

HOST PLANTS.—Peach-leaved willow (*Salix amygdaloides*); occurs also to some extent on other willows.

KNOWN DISTRIBUTION.—A common, Holarctic species.

Illinois Records.—Seventy-four males and 70 females, taken April 15 to Nov. 15, are from Alton, Antioch, Beardstown, Bloomington, Browns, Cairo, Carbondale, Chicago, Dongola, Elizabeth, Elizabethtown, Freeport, Galena, Galesburg, Geff, Golconda, Grafton, Grand Detour, Grand Tower, Harrisburg, Hatton, Havana, Herod, Hopedale, Kankakee, Lilly, Marshall, Meredosia, Monticello, Mount Carmel, Oquawka, Oregon, Putnam, Quincy, Rockford, Savanna, Springfield, Starved Rock State Park, Thebes, Urbana, Volo, West Union, White Pines Forest State Park, York.

Lygus pabulinus (Linnaeus)

Cimex pabulinus Linnaeus (1761, p. 253).

MALE.—Length 5.50, width 2.00; body elongate. General color pale green or greenish yellow, frequently fading to dull yellowish; carina of vertex indistinct in middle; a fuscous Y-shaped mark formed at extreme anal area of membrane; usually a spot present within apices of areoles, and

a longitudinal cloud extending beyond areoles to tip of membrane. Genital claspers as in fig. 161.

Female. — Length 6.10, width 2.22; slightly larger and more robust than male, but not differing in coloration.

Host Plant.—Touch-me-not (*Impatiens biflora*).

Known Distribution. — Europe and Boreal America; apparently Holarctic in distribution.

Illinois Records.—Eight males and 11 females, taken May 7 to Oct. 6, are from Antioch, Bloomington, Bowmanville, Dubois, Elizabethtown, Evanston, Fountain Bluff, Herod, Karnak.

Lygus campestris (Linnaeus)

Cimex campestris Linnaeus (1758, p. 448).

Male.—Length 4.10, width 1.77. Ovate, rather small. General color greenish brown or brownish yellow with fuscous areas; scutellum bright yellow or green; genital claspers, fig. 161, distinctive for species.

Female.—Slightly more robust than male; second antennal segment more slender; very similar to male in coloration.

Food Plants.—Poison hemlock (*Conium maculatum*) and other plants of the family Umbelliferae; Illinois specimens have been collected on wild parsnip (*Pastinaca sativa*) and cow parsnip (*Heracleum lanatum*). Reported in Massachusetts and New Brunswick as a pest on celery plants.

Known Distribution.—Common in the northern states and Canada; Holarctic in distribution.

Illinois Records. — Seventy-one males and 83 females, taken April 12 to Oct. 9, are from Algonquin, Allerton, Antioch, Browns, Champaign, Elizabeth, Lawrenceville, Oregon, Palos Park, St. Joseph, Seymour, Spring Grove, Urbana, Waukegan, Willow Springs, Worth.

Lygus apicalis Fieber

Lygus apicalis Fieber (1861, p. 275).
Lygus Carolinae Reuter (1876, p. 71).

Lygus carolinae Reuter has remained an enigma to American Hemipterists up to the present time. Mr. W. L. McAtee visited the Stockholm museum in 1927 and at the writer's request examined the type of *carolinae* and drew the genital claspers. These distinctive structures leave no doubt about the identity of the species and its synonymy with *apicalis* Fieber.

Male.—Length 4.50–5.00, width 2.00; body oblong; head broad, width 1.12, vertex 0.29, eyes unusually large. General color greenish, dark green, or yellowish green; membrane, and, in some cases, corium, marked with fuscous; genital claspers distinctive for species, fig. 161.

Female.—Length 4.60, width 2.05; width of head 1.05, vertex 0.37; uniformly green or greenish yellow; eyes dark brown; tip of tarsi and apex of rostrum very dark brown.

Host Plant.—Fleabane (*Erigeron canadensis*).

Known Distribution.—Throughout the eastern United States, and known also from Europe, Mexico, Central America and islands of the Pacific.

Illinois Records. — Twenty-seven males and 32 females, taken June 24 to Nov. 11, are from Cypress, Grand Tower, Hardin, Lawrenceville, McClure, Monticello, Mounds, Quincy, Shawneetown, Ullin, Urbana, Villa Ridge, Ware.

Neolygus Knight

KEY TO SPECIES

1. Pronotal disk greenish, or yellowish to brownish, but without distinct dark rays 2
   Pronotal disk black or marked with dark rays 23
2. Color chiefly greenish, old specimens frequently fading to yellowish; sometimes darkened on clavus and at tip of corium, but ground color green 3
   Color distinctly yellowish or brownish, more brownish than green 9
3. Tibial spines with fuscous spots at base; corium never infuscated, but inner half faintly bronzed; clavus and basal half of pronotum usually bronzed .... **alni,** p. 157
   Tibial spines without fuscous spots at base 4
4. Dorsum uniformly greenish, with a small, fuscous mark beginning at inner apical angles of corium and extending transversely across anal area of membrane; length 5.20–5.70 .... **neglectus,** p. 162

Dorsum partly brownish; apical area of corium and usually clavus distinctly brownish, sometimes dark brown or even fuscous........... 5

5. Membrane with apical half infuscated along median line, this darkened area forming a distinct, longitudinal ray which may be widened apically; corium with a triangular dark brownish spot just before apex, clavus usually brownish; length 5.60–6.00..........**belfragii**, p. 162

Membrane never forming a median, longitudinal fuscous ray; smaller forms.......................... 6

6. Apical one-fifth of second antennal segment infuscated............. **canadensis** var. **canadensis**, p. 164

Second antennal segment uniformly colored........................ 7

7. Scutellum partly fuscous; clavus also more or less darkened; corium with a triangular dark patch before apex ....**tiliae**, p. 161

Scutellum pale; clavus and apex of corium usually darkened......... 8

8. Area of clavus bordering scutellum dark brown; apical half of membrane clear, a fuscous spot at margin either side of middle, a spot also bordering tip of cuneus.......... ....**inconspicuus**, p. 161

Area of clavus bordering commissure as well as along scutellum dark brown; apical half of membrane rather uniformly infuscated...... ....**clavigenitalis**, p. 163

9. Rostrum scarcely attaining apices of intermediate coxae; color rich yellowish brown, darker on clavus and apex of corium.................10

Rostrum extending beyond apices of intermediate coxae...............11

10. Second antennal segment darkened at apex, its length greater than width of pronotum at basal margin ....**viburni**, p. 159

Second antennal segment not infuscated, its length less than width of pronotum at base. .**nyssae**, p. 164

11. Apical half of tylus black; two reddish bands present near apices of hind femora; sides of body red......... ....**atritylus**, p. 157

Tylus not black, or, if so, then body and bands on femora not reddish. .12

12. Hind femora without two distinct bands near apices; when dark, paler only at tip; second antennal segment rarely darkened, if so, bands on femora indistinct.............13

Hind femora with distinct dark or light bands near apices; second antennal segment darkened apically. .21

13. Scutellum dark, with a pale, median stripe on apical half; dorsum dark greenish brown to almost black, a lateral, dark fuscous stripe extending full length of body; femora dark with pale tips........**invitus**, p. 157

Scutellum sometimes dark, but without any indication of a pale median line............................14

14. Color distinctly reddish; head, pronotum, femora and veins of membrane red...........**tinctus**, p. 157

Color not reddish..................15

15. Hemelytra uniformly rich brownish, or brownish pink; clavus and apical half of hemelytra not appreciably darker........................16

Hemelytra not uniformly colored; clavus and apical half of corium darker than scutellum and basal half of corium..................18

16. Hemelytra and femora brownish pink; membrane distinctly darkened.... ....**fagi**, p. 161

Hemelytra reddish yellow brown to black, or uniformly rich brownish; membrane darkened, or uniformly yellowish.....................17

17. Dorsal prongs of left genital clasper parallel or converging at tips, fig. 164............**hirticulus**, p. 163

Dorsal prongs of left genital clasper divergent at tips, fig. 164......... ....**geminus**, p. 163

18. Second antennal segment darkened apically........................19

Second antennal segment uniformly colored, never distinctly darkened apically........................20

19. Length 4.70–5.00; female vertex distinctly wider than dorsal width of an eye; male left genital clasper with basal spine shorter and more slender than posterior spine, fig. 164 ....**carpini**, p. 164

Length 5.50–6.00; female vertex narrower than dorsal width of an eye; male left genital clasper with basal

spine longer and stouter than posterior spine, fig. 164. . **ostryae,** p. 164

20. Length of second antennal segment scarcely exceeding width of posterior margin of pronotum; rostrum scarcely attaining apices of hind coxae; hemelytra greenish yellow with apical spot on corium and inner margins of clavus dark brownish to almost black. . . . . **clavigenitalis,** p. 163
    Length of second antennal segment much exceeding width of posterior margin of pronotum; rostrum extending slightly beyond apices of hind coxae; clavus and corium dark brownish. . . . . . . **geneseensis,** p. 159
21. Pale greenish yellow; clavus and large spot on apical half of corium very dark brown; femora greenish yellow, with faint, fuscous bands near apices. . . . . **canadensis** var. **canadensis,** p. 164
    Color yellowish to brownish; apical half of corium brownish, but this colored area not forming a definite spot; femora brownish or reddish. . 22
22. Femora and, usually, sides of body distinctly reddish; hind femora with dark reddish bands before apices. . . . . **quercalbae,** p. 160
    Femora and sides of body dark brown to fuscous; hind femora with dark brown bands before apices. . . . . **omnivagus,** p. 163
23. Pronotal disk dark, but without distinct rays. 24
    Pronotal disk with distinct, dark rays or spots behind calli. 27
24. Sides of body and hind femora distinctly reddish; femora with pale and dark red bands near apices. **quercalbae,** p. 160
    Sides of body and femora not reddish. 25
25. Hind femora black, with paler bands near apices; hemelytra black, costal margin scarcely paler, cuneus clear, apex dark. . . . . **caryae** var. **caryae,** p. 161
    Hind femora greenish to brownish, without subapical bands. 26
26. Embolium greenish, clavus and inner half of corium dark fuscous to almost black. . . . . **tiliae,** p. 161
    Embolium scarcely paler than corium, hemelytra and whole dorsum nearly uniformly dark brown. . . . . **hirticulus,** p. 163
27. Hind femora with two dark brown or pale bands near apices. 28
    Apical halves of hind femora dark brown to black, but without two distinct bands, pale only at apices. 32
28. First and second antennal segments black; embolium, outer half of corium and cuneus, pale and translucent. . . . . **johnsoni,** p. 162
    First antennal segment pale or only slightly brownish; apex of embolium and outer half of corium darkened; if not, then first antennal segment distinctly pale. 29
29. Sides of body and usually hind femora distinctly reddish. . **communis,** p. 159
    Sides of body and femora not reddish. 30
30. Embolium and basal half of corium pale, a large black spot on apical half of corium; clavus and a nearly quadrate spot behind each callus black; calli and areas just anterior to them not black. . . . . **canadensis** var. **binotatus,** p. 164
    Embolium usually darkened apically; if not, then calli and areas just anterior to them black. 31
31. Apex of median line of scutellum and all but cuneus of hemelytra dark brown to black. . . . . **caryae** var. **caryae,** p. 161
    Scutellum and basal half of corium and embolium distinctly pale. . . . . **caryae** var. **subfuscus,** p. 161
32. Scutellum with a darkened median line; apex and inner margin of cuneus, femora and variable areas on sides of body, reddish. . . . . **univittatus,** p. 160
    Scutellum never with a dark brown median line. 33
33. Pronotal disk with small fuscous mark behind each callus; venter dark brown, with a pale, lateral stripe. . . . . **semivittatus,** p. 163
    Pronotal disk with distinct black ray or spot behind each callus; venter without pale, lateral stripe. 34
34. Pronotal disk with two conspicuous, nearly square black spots, one behind each callus; ground color yellowish brown; hind femora black except at tips. . . **atrinotatus,** p. 162

A black stripe traversing outer half of each callus and extending to posterior margin of pronotal disk; ground color pale yellowish, with clavus and apices of corium and embolium black...**vitticollis**, p. 162

Neolygus invitus (Say)

Capsus invitus Say (1832, p. 24).

MALE.—Length 5.00, width 2.00. General color dark greenish with fuscous or black areas; a lateral, fuscous stripe extending full length of body, including genital segment; apical half of scutellum with a pale, median vitta; disk of pronotum dark brown or black, but never with two distinct rays, as in *communis* Knight; genital claspers distinctive for species, fig. 164.

FEMALE.—Length 5.10, width 2.20; slightly more robust than male, very similar in coloration, but in general lighter colored, with pale vitta on scutellum longer.

FOOD PLANT.—American elm (*Ulmus americana*); a single specimen was collected in Illinois on hickory (*Carya* sp.).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Indiana, Iowa, Massachusetts, Michigan, Minnesota, Missouri, New York, Ohio, Vermont.

Illinois Records.—ILLINOIS: June 21, 1892, 2♀. DUBOIS: May 21, 1917, 1♂. ELIZABETHTOWN: May 27-31, 1932, on elm, H. L. Dozier, 10♂, 6♀. FRANKFORT: June 8, 1933, Mohr & Townsend, 2♂, 9♀. MOUNT CARMEL: May 27, 1884, on leaves of *Carya* sp., 1♀. MUNCIE: June 8, 1917, 1♀. SAVANNA: June 1, 1917, 1♀; June 12, 1917, 3♂, 1♀.

Neolygus tinctus new species

This species is distinguished from allied ones by its smaller size and reddish coloration; it apparently is most closely related to *invitus* (Say).

MALE.—Length 4.76, width 2.00. Head width 0.99, vertex 0.30. Rostrum yellowish, apex reddish brown, length 1.56, extending slightly beyond middle of hind coxae. Antennae, first segment, length 0.44, yellowish brown; second, 1.56, yellowish, becoming dusky at apex. Pronotum reddish; basal half of disk fuscous; calli dusky brown; median line of side of pronotum paler just behind calli. Propleuron pale about coxal cleft. Scutellum yellowish, with many red flecks in hypodermis. Hemelytra reddish to fuscous, with clavus and apical half of corium distinctly fuscous; cuneus pale, flecked with red about margins; membrane pale, with red veins and with areas within areoles and along margin behind cuneus fuscous. Dorsum clothed with fine, yellowish, recumbent pubescence; pronotum and scutellum minutely regulose, as in allied species. Venter of body pale yellowish, tinged with reddish and shaded with fuscous; sides of thorax dusky. Legs yellowish green, hypodermis of femora rather uniformly colored with bright red; tarsi darkened. Genital claspers distinctive, fig. 164; form nearest to *invitus*, but left clasper thicker at base and right clasper with a much more prominent, protuberant shoulder at middle.

FEMALE.—Length 4.63, width 2.20. Head with frons, tylus and juga bright red. Antennae yellowish, first segment becoming reddish at apex, third and fourth segments dusky; first segment, length 0.47; second, 1.47; third, 0.82; fourth, 0.34. More robust than male, and very similar in coloration, although with less fuscous shading on pronotum and hemelytra.

Holotype, male. — Morgan County, Ind.: June 10, 1933, on *Gleditsia triacanthos*, P. O. Musgrave, KC.

Allotype, female. — ILLINOIS. — EICHORN, HICK'S BRANCH: June 13, 1934, DeLong & Ross.

Neolygus atritylus Knight

Lygus (*Neolygus*) *atritylus* Knight (1917*b*, p. 606).

No Illinois specimens; known from Colorado, Minnesota, New Hampshire, New York, Vermont. Feeds on willow (*Salix* sp.).

Neolygus alni Knight

Lygus (*Neolygus*) *alni* Knight (1917*b*, p. 607).

MALE.—Length 5.50–6.00, width 2.00. Head width 1.00, vertex 0.33. Rostrum, length 1.88, just attaining posterior margins of hind coxae. Antennae, first segment, length 0.64; second, 2.02, yellowish to brownish, its apex not strongly infuscated; third, 1.04; fourth, 0.74. Pronotum, length 0.86, width at base 1.57. Color medium green to light green, fading to yellowish in old specimens; clavus, scutellum and basal

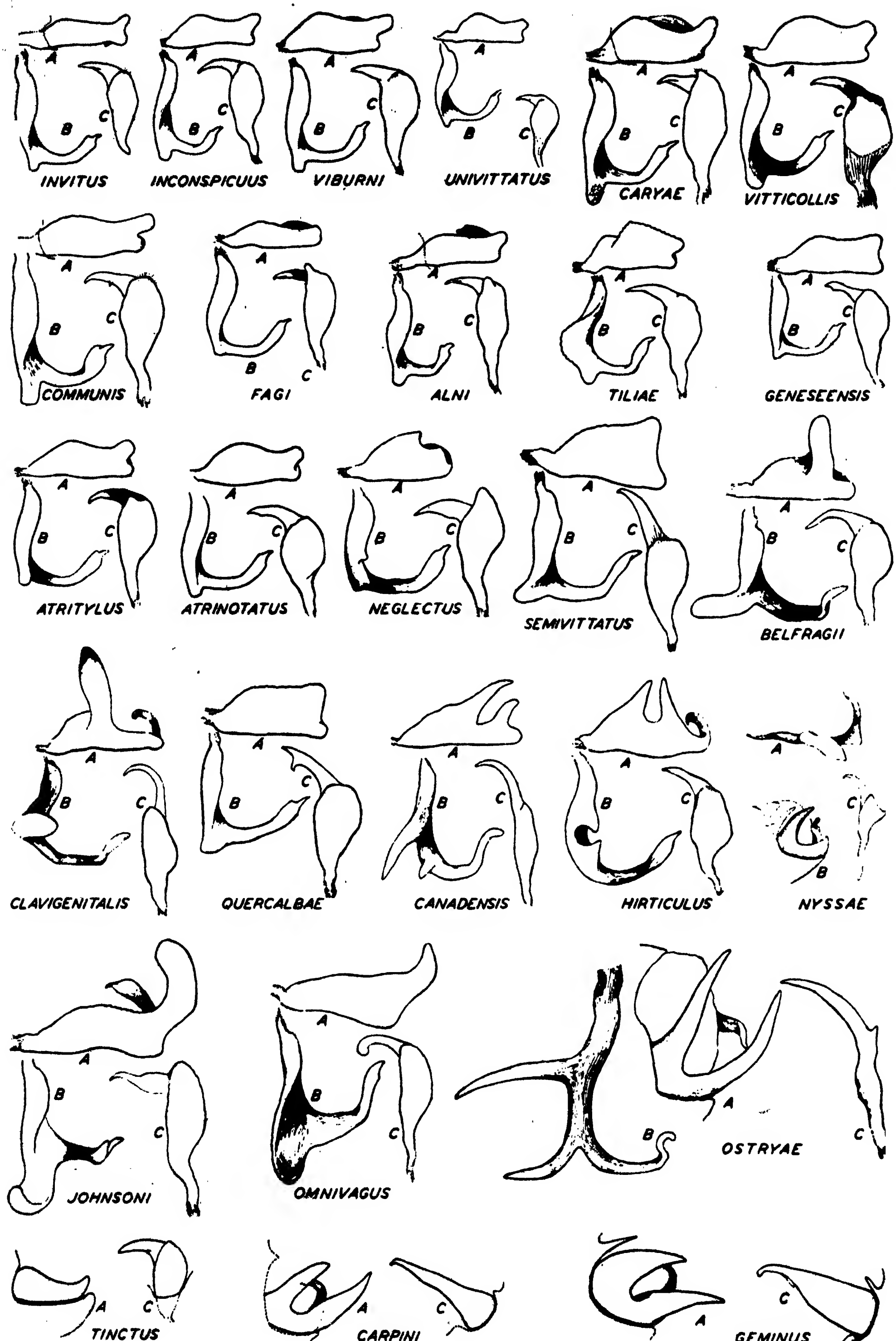


Fig. 164.—Male genital claspers of *Neolygus*. *A*, left clasper, lateral aspect; *B*, left clasper, dorsal aspect; *C*, right clasper, ventral aspect.

half of pronotal disk usually distinctly bronzed. Membrane slightly smoky, with apical part of cells and a narrow transverse spot at apex of cuneus darker, veins pale to dusky. Legs greenish, each tibial spine with fuscous spot at base. Venter bright green to yellowish green. Genital claspers, fig. 164, distinctive for species.

FEMALE.—Length 5.50, width 1.95. Form, color and pubescence very similar to those of male.

HOST PLANT.—Alder (*Alnus incana*).

KNOWN DISTRIBUTION.—Illinois, Minnesota, New Hampshire, New York, Nova Scotia, Quebec.

Illinois Record.—HEROD: June 20, 1935, DeLong & Ross, 1 ♂.

Neolygus geneseensis Knight

Lygus (*Neolygus*) *geneseensis* Knight (1917*b*, p. 609).

MALE.—Length 5.00, width 2.05. General color yellowish brown to dark brown and fuscous. Allied to *viburni* Knight, having much the same color, but differs in being slightly smaller, having a longer rostrum and differently shaped genital claspers, fig. 164.

FEMALE.—Length 4.90, width 2.10; very similar to male, but more uniformly yellowish brown; distinguished from *viburni* by having uniformly yellowish antennae, and by the rostrum, which extends to posterior margins of hind coxae.

FOOD PLANTS.—White oak (*Quercus alba*) and post oak (*Q. stellata*).

KNOWN DISTRIBUTION. — Georgia, Illinois, Iowa, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New York, Pennsylvania, Virginia.

Illinois Records.—Fifteen males and 13 females, taken May 25 to July 4, are from Beach, Charleston, Elizabethtown, Frankfort, Galena, Geff, Grand Detour, Harvard, Marshall, Oakwood, Palos Park, St. Joseph, White Heath, White Pines Forest State Park.

Neolygus viburni Knight

Lygus (*Neolygus*) *viburni* Knight (1917*b*, p. 609).

MALE.—Length 5.20, width 2.08; width of head 1.03, vertex 0.38. Rostrum short, its apex scarcely attaining posterior margins of mesocoxae. Similar to *omnivagus* Knight, but is smaller and more yellowish brown than that species. It also is closely related to *geneseensis* Knight, but is more robust and has a shorter rostrum; the apical half of the second antennal segment is darkened, and the general coloration is a richer yellowish brown. Claspers, fig. 164, distinctive for species.

FEMALE.—Length 5.30, width 2.28; very similar to male in coloration, but usually not so dark.

FOOD PLANT.—Sheepberry (*Viburnum lentago*). In New York state this bug often occurs in such numbers that foliage of its host is badly injured.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Michigan, Minnesota, New York, Ohio, Pennsylvania.

Illinois Records.—GALENA: June 30, 1932, Dozier & Mohr, 1 ♂, 1 ♀. GALESBURG: July 16, 1892, 2 ♀.

Neolygus communis Knight

Pear Plant Bug

Lygus (*Neolygus*) *communis* Knight (1916*a*, p. 346).

This species, fig. 165, is suggestive of *invitus* (Say), but may easily be distinguished from it by the two black rays on the disk of the pronotum, the reddish lateral stripe on the body and the larger size.

MALE.—Length 5.50, width 2.30. Antennae with second segment dark brownish to fuscous, sometimes with basal half paler; third dark brown; fourth fuscous. Pronotum greenish, darkened with brown on basal half; two black rays on disk, one behind each callus and, in the darkest specimens, extending across calli, widened behind and nearly reaching hind margin. Scutellum greenish, darkened with brown; rarely with a longitudinal, median, fuscous line. Hemelytra dark brown to fuscous, darker on apical half of corium and across tip of embolium; cuneus clear, tinged with yellow, extreme tip sometimes slightly darkened; membrane darkened. Legs greenish to yellowish, posterior femora and often intermediate femora with two reddish annulations near each apex; frequently entire apical halves reddish. Venter pale greenish with a broad, lateral band and the genital segment dark brownish red; genital claspers distinctive for species, fig. 164.

FEMALE.—Length 5.40, width 2.40. More

robust than male, but very similar in color and pubescence.

Food Plants and Habits.—Breeds on dogwoods (*Cornus stolonifera, C. paniculata* and *C. alternifolia*) and cultivated pear (*Pyrus communis*); also reared from winterberry (*Ilex verticillata*). The nymphs hatch when the leaves unfold and they feed

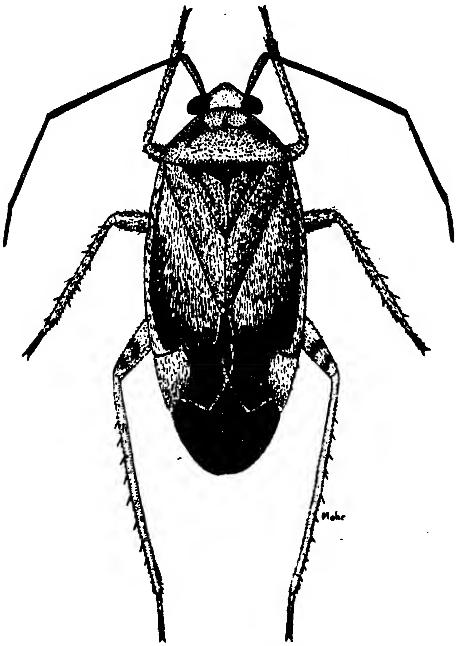


Fig. 165.—*Neolygus communis*, ♀.

on this tender foliage. On pears, the nymphs attack the young fruit as soon as it forms and continue to feed on it in preference to the leaves. All pears thus punctured become knotty and scarred to such an extent that the fruit is unsalable. The nymphs are green, closely matching the color of the young fruit; this makes it difficult to see them. The nymphs mature in about 24 days, or, usually, by the middle of June in central Illinois. The adults, likewise, prefer to feed on the pears and contribute further to the destruction of the fruit. In New York, the author observed that the adult bugs were active agents in distributing pear blight among the trees, the blight developing about feeding punctures made by the bugs. Oviposition occurs during the last week of June and up to the middle of July in New York, a few individuals probably laying after that date. The eggs are inserted under the bark of the new cambium layer (Knight 1915); in one place six eggs were found deposited in a mass. Most of the males die by the middle of July, but many females live until the end of that month. There is only one brood annually; the winter is passed in the egg stage and the nymphs appear again in the spring at the time the leaves unfold. In Nova Scotia a smaller, more slender form, variety *novascotiensis* Knight (1916*a*, p. 349), is an important pest on apple fruit.

Known Distribution.—Colorado and Idaho northward to Alberta and Minnesota, eastward to Ontario and Maine and southward to North Carolina.

Illinois Records.—Antioch: Aug. 1, 1924, T. H. Frison, 1 ♀; July 5-7, 1932, T. H. Frison, on *Ilex verticillata*, 4 ♂, 20 ♀. Frankfort: June 8, 1933, Mohr & Townsend, 3 ♀. Quincy: June 11-30, 1883, lowlands, 1 ♀. St. Joseph: June 17, 1932, T. H. Frison, 1 ♀.

Neolygus univittatus Knight

Lygus (*Neolygus*) *univittatus* Knight (1917*b*, p. 623).

Known only from New York, but intensive collecting on its host plant, hawthorn (*Crataegus* sp.), should extend its recorded range.

Neolygus quercalbae Knight

Lygus (*Neolygus*) *quercalbae* Knight (1917*b*, p. 624).

Male.—Length 5.70, width 2.40. Resembles *omnivagus* Knight, but is deeper reddish brown, more robust, and has a pale stripe on either side of venter; similar to *semivittatus* Knight in coloration of venter, but does not have distinct, fuscous spots behind calli and is more red in color; genital claspers, fig. 164, distinctive.

Female.—Length 5.60, width 2.60; more robust than male, but very similar in coloration; larger and more reddish than *omnivagus* and *semivittatus;* distinguished from them by the distinctly reddish hind femora and sides of body.

Food Plant.—White oak (*Quercus alba*) on which it is often very abundant. This species has been collected on peach trees and hickory (*Carya ovata*) along with *N. caryae* Knight, but breeds only on white oak so far as the writer has been able to determine. The nymphs hatch with the bursting of the buds and feed thereafter on the

tender foliage. In times of rain or cold weather the nymphs retreat under the bud scales which remain on the trees. Up to the fourth instar the nymphs are greenish yellow, but later they become tinged with pink; in the last instar the wing pads become brownish while the body is pink. In western New York the nymphs are developing during May and usually begin maturing during the first week of June; the adults may remain on the trees up to the middle of July. Eggs are laid mostly in late June and early July in the oak twigs; there they pass the winter, and the nymphs come forth with the bursting of the buds the following spring.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New York, Ontario, Virginia, Wisconsin.

Illinois Records.—Twenty males and 18 females, taken May 9 to July 6, are from Algonquin, Antioch, Beach, Cedar Lake, Dongola, Dubois, Elizabeth, Frankfort, Galena, Glen Ellyn, Goreville, Grand Detour, Harvard, Meredosia, Oregon, St. Anne, Savanna, Urbana, Willow Springs, Zion.

Neolygus fagi Knight

Lygus (*Neolygus*) *fagi* Knight (1917*b*, p. 603).

Not as yet collected in Illinois; known from Massachusetts, New Hampshire, New York, Ohio, Vermont. Feeds on beech (*Fagus grandifolia*) and birch (*Betula lutea*).

Neolygus inconspicuus Knight

Lygus (*Neolygus*) *inconspicuus* Knight (1917*b*, p. 612).

MALE.—Length 4.50, width 2.08. General color pale greenish; a transverse brownish spot at apex of corium and on area of clavus bordering scutellum; in general appearance, resembling *tiliae* Knight and *clavigenitalis* Knight, but differing greatly from those species in form of genital claspers, fig. 164.

FEMALE.—Length 4.80, width 2.25; very similar to male in size and coloration; similar in size and general appearance to *clavigenitalis* and *tiliae;* distinguished from the latter by the pale scutellum, and from the former by being more greenish with a paler scutellum.

FOOD PLANT.—Muscadine grape (*Vitis rotundifolia*).

KNOWN DISTRIBUTION.—Connecticut, Georgia, Illinois, Indiana, Iowa, Maryland, Michigan, Minnesota, New York, North Carolina, Oklahoma, Virginia.

Illinois Records.—NORTHERN ILLINOIS: June, 1 ♀. ALDRIDGE: May 8, 1932, H. L. Dozier, 1 ♀. ELIZABETH: July 6, 1917, 1 ♂. FREEPORT: July 4, 1917, 1 ♂. OREGON: June June 11, 1933, Mohr & Townsend, 1 ♀. WILLOW SPRINGS: July 3, 1904, W. J. Gerhard, 1 ♀, FM.

Neolygus tiliae Knight

Lygus (*Neolygus*) *tiliae* Knight (1917*b*, p. 613).

MALE.—Length 4.60, width 1.74; rather small, scarcely as large as *invitus* (Say). General color greenish yellow, with base of pronotum darker, and scutellum, clavus and corium dark fuscous to black. Genital claspers distinctive, fig. 164.

FEMALE.—Length 5.00, width 2.00. Lighter colored than male and usually slightly larger; pronotum yellowish, scutellum and clavus only slightly darkened, apex of corium with a triangular dark patch, much resembling *belfragii* (Reuter) in this respect; similar in size and general appearance to *inconspicuus* Knight and *clavigenitalis* Knight; distinguished from *inconspicuus* by having front of head more conic and scutellum darker; *clavigenitalis* differs from this species in being generally more brownish with a paler scutellum.

FOOD PLANT.—Linden (*Tilia americana*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Massachusetts, Minnesota, New York, Ohio, Ontario, Pennsylvania, Vermont.

Illinois Records.—Sixty-seven males and 53 females, taken June 8 to July 19, are from Algonquin, Antioch, Elizabeth, Frankfort, Freeport, Galena, Galesburg, Kampsville, Monticello, Oregon, Urbana, Waukegan.

Neolygus caryae Knight

Lygus (*Neolygus*) *caryae* Knight (1917*b*, p. 615).

MALE.—Length 4.80–5.70, width 2.10. General color varying from dark brown or black to yellowish brown with more prominent dark areas on pronotum and apex of

hemelytra. Paler brown forms suggest *omnivagus* Knight. Genital claspers distinctive, fig. 164.

FEMALE.—Length 5.00–6.30, width 2.30; more robust than male, frequently with brownish yellow areas between the calli and over posterior part of disk.

Specimens which are towards the pale end of the series with a more or less prominently banded effect represent the variety *subfuscus* Knight (1917*b*, p. 616); they resemble *omnivagus* in coloration. Specimens that show all ranges of color have been taken in Illinois, frequently both extremes and the intergrades together on the same tree.

FOOD PLANTS.—Hickory (*Carya ovata*) and pecan (*C. illinoensis*). Also, single Illinois specimens were taken on locust (*Robinia pseudoacacia*), oak (*Quercus* sp.) and red cedar (*Juniperus virginiana*). There is no evidence that they fed on these hosts.

Of recent years this species has been reported several times as causing "cat-facing" on peaches in New York and Ohio. The species may breed on nearby hickory trees and, when mature, fly to the peach trees where they puncture and feed upon the young fruits.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New York, North Carolina, Ohio, Ontario, Texas.

Illinois Records.—Sixty-two males and 58 females, taken May 15 to July 6, are from Antioch, Bluff Springs, Dubois, Elizabethtown, Fox Lake, Frankfort, Freeport, Galena, Galesburg, Glen Ellyn, Goreville, Grand Detour, Grayslake, Hardin, Harvard, Havana, Kampsville, Manito, Meredosia, Oquawka, Rockford, Savanna, Seymour, Urbana, Waukegan, White Pines Forest State Park, Zion.

Neolygus atrinotatus Knight

Lygus (*Neolygus*) *atrinotatus* Knight (1917*b*, p. 617).

Known from District of Columbia, North Carolina, Ohio, Pennsylvania; not yet collected in Illinois.

Neolygus vitticollis (Reuter)

Lygus vitticollis Reuter (1876, p. 71).

MALE.—Length 5.80, width 2.48; elongate, easily separated from other species by its large size and distinct black markings. General color pale yellowish, with two rays on pronotum; clavus, apical halves of posterior femora, and apices of corium and of embolium, black; rostrum reaching only intermediate coxae; genital claspers, fig. 164, distinctive.

FEMALE.—More robust than male, but not differing in coloration.

FOOD PLANTS.—Sugar maple (*Acer saccharum*), red maple (*A. rubrum*) and silver maple (*A. saccharinum*).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Indiana, Iowa, Michigan, Minnesota, New Jersey, New York, Ohio, Ontario. In the original description Reuter gave Texas as the type locality for *vitticollis*, but Mr. W. L. McAtee examined the type in the Stockholm Museum in 1927 and reported that it was labeled "N. Y."

Illinois Records.—Twenty-four males and 37 females, taken May 11 to July 1, are from Algonquin, Antioch, Carlinville, Meredosia, Mount Carmel, Normal, Oakwood, Oquawka, Savanna, Urbana, White Heath.

Neolygus neglectus Knight

Lygus (*Neolygus*) *neglectus* Knight (1917*b*, p. 619).

Known from Alabama northward to Maine and westerly from Louisiana, Mississippi, Ohio. This species has not as yet been taken in Illinois, but it should be found here eventually. Feeds on American hornbeam (*Carpinus caroliniana*).

Neolygus johnsoni Knight

Lygus (*Neolygus*) *johnsoni* Knight (1917*b*, p. 629).

No Illinois specimens; known from New York, Ohio, Virginia. Feeds on hornbeam (*Carpinus caroliniana*).

Neolygus belfragii (Reuter)

Lygus belfragii Reuter (1876, p. 71).

MALE.—Length 5.80, width 2.30; elongate. General color green or greenish yellow; clavus brownish, tinged with fuscous and bronze; apex of corium with a triangular fuscous or blackish patch, membrane with a median, longitudinal, fuscous area; genital claspers distinctive, fig. 164.

FEMALE.—Length 5.50–5.80; similar to male in coloration, but more robust.

HOST PLANTS.—Breeds on *Acer spicatum* and *Viburnum acerifolium.*

KNOWN DISTRIBUTION.—Illinois, Maine, Minnesota, New York, Ontario, Pennsylvania, Wisconsin.

Illinois Record.—DOLSON: July 18, 1934, Rocky Branch, DeLong & Ross, 1 ♀.

Neolygus clavigenitalis Knight

Lygus (Neolygus) clavigenitalis Knight (1917*b*, p. 632).

Known from Connecticut, Maine, Maryland, Massachusetts, Ohio, but not yet collected in Illinois. Has been collected on smooth alder (*Alnus rugosa*).

Neolygus semivittatus Knight

Lygus (Neolygus) semivittatus Knight (1917*b*, p. 626).

Not yet taken in Illinois, but it should be found here eventually. Known from Alabama, Florida, Minnesota, Mississippi, New York, Pennsylvania, Texas, Virginia; feeds on white oak (*Quercus alba*).

Neolygus omnivagus Knight

Lygus (Neolygus) omnivagus Knight (1917*b*, p. 627).

MALE.—Length 5.40, width 2.20. Yellowish brown with apex of corium dark brown to fuscous; clavus dark brown or black; very much resembling forms of *semivittatus* Knight and *quercalbae* Knight; also similar in color to *caryae subfuscus* Knight, but genital claspers distinctive, fig. 164.

FEMALE.—Length 5.40, width 2.50. Usually paler than male, more yellowish brown; never reddish, as in *quercalbae*, nor with fuscous marks on pronotum as in *semivittatus* or *caryae subfuscus;* very similar to *canadensis* Knight, but that species has apical one-third of second antennal segment distinctly black, fuscous spot on apex of the corium smaller and embolium entirely without fuscous.

FOOD PLANTS.—White oak (*Quercus alba*), red oak (*Q. rubra*), scarlet oak (*Q. coccinea*) and probably other oaks; breeds occasionally on dogwood (*Cornus* sp.), chestnut (*Castanea* sp.) and arrow-wood (*Viburnum* sp.).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, Ontario, Pennsylvania, Quebec, Rhode Island, Vermont, Virginia, Wisconsin.

Illinois Records.—Eleven males and 25 females, taken June 4 to July 31, are from Dolson, Galena, Glen Ellyn, Grand Detour, Keithsburg, Lilly, Marshall, McHenry, Monticello, Mount Carroll, Oregon, Rockford, St. Anne, Savanna, White Pines Forest State Park, Willow Springs.

Neolygus hirticulus (Van Duzee)

Lygus tenellus Van Duzee (1912, p. 484), *not* Hahn.

Lygus hirticulus Van Duzee (1916*a*, p. 41).

MALE.—Length 4.80, width 2.28. General color dark ferrugino-testaceous, sometimes entirely dark fuscous or black, except for the legs and antennae; genital claspers distinctive, fig. 164.

FEMALE.—Length 5.30, width 2.30. Slightly larger and more robust than male. Uniformly colored with yellowish brown or, in some cases, dark brown; hemelytra rarely much darker than pronotum; easily confused with *fagi* Knight, but membrane is uniformly and faintly tinged with fuliginous color, never dark as in *fagi.*

FOOD PLANTS.—Chestnut (*Castanea* sp.), sugar maple (*Acer saccharum*), beech (*Fagus sp.*), ash (*Fraxinus* sp.), cottonwood (*Populus deltoides*) and woodbine (*Psedera* sp.).

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Ontario, Pennsylvania, Rhode Island, Vermont. Always rare.

Illinois Records.—ILLINOIS: 1 ♂; July 9, 1892, 1 ♀; July 16, 1892, 1 ♀. DUBOIS: June 3, 1919, 1 ♂. FRANKFORT: June 8, 1933, on *Fraxinus* sp., Mohr & Townsend, 3 ♂. URBANA: June 30, 1889, woods above lake, 1 ♂; July 20, 1917, cottonwoods, 1 ♂; July 27, 1917, cottonwood grove, 1 ♀. WILLOW SPRINGS: July 8, 1906, W. J. Gerhard, 1 ♀, FM.

Neolygus geminus new species

This is closely allied to *hirticulus* (Van Duzee), as individuals of the two species are similar in size and coloration, but the males are readily distinguished by the structure of the genital claspers, fig. 164.

MALE.—Length 4.80, width 2.20. Head width 0.91, vertex 0.34. Rostrum, length 1.81, almost attaining posterior margins of hind coxae. Antennae, first segment, length 0.58, pale; second, 1.98, pale to yellowish brown; third, 1.17, dusky yellow; fourth, 1.21, dusky. Pronotum, length 0.95, width at base 1.70. Color dusky brown, hemelytra slightly darker; cuneus pale, translucent; membrane pale to smoky, veins yellowish. Legs pale to yellowish; femora tending to yellowish brown. Venter yellowish to brown, darker on sides; genital claspers distinctive.

FEMALE.—Length 5.00, width 2.30. Head width 0.95, vertex 0.39; antennae, first segment, length 0.60; second, 1.94; third, 1.17. Pronotum, length 1.08, width at base 1.77. Slightly more robust than male and more yellowish brown in color. Cannot at present be separated from female of ***hirticulus***.

Holotype, male.—Elizabethtown, Ill.: May 27-31, 1932, H. L. Dozier.

Allotype, female.—Same data as for holotype.

Paratypes.—ILLINOIS.—Same data as for holotype, 4 ♂, 1 ♀. GOLCONDA: June 22, 1932, on *Trifolium pratense*, Ross, Dozier & Park, 1 ♂.

Neolygus nyssae Knight

Lygus (*Neolygus*) *nyssae* Knight (1918*c*, p. 43).

MALE.—Length 5.50, width 2.50; slightly more robust, but in general structure similar to *quercalbae* Knight; pronotum and scutellum evenly shaded with rich brown; clavus and corium darker brown; genital claspers distinctive for species, fig. 164.

FEMALE.—Length 5.60, width 2.57; very similar to male in size and coloration.

FOOD PLANT.—Sour gum (*Nyssa* sp.).

KNOWN DISTRIBUTION.—Alabama, Connecticut, Illinois, Mississippi, Ohio, Pennsylvania.

Illinois Record.—DIXON SPRINGS: June 24, 1936, DeLong & Ross, 1 ♀.

Neolygus canadensis Knight

Lygus (*Neolygus*) *canadensis* Knight (1917*b*, p. 634).

This species is allied to *omnivagus* Knight, but is more greenish yellow in color and has a distinct, dark spot on the corium. The only specimen seen from Illinois has a black ray behind each callus extending nearly to the hind margin of the pronotum and would, thus, be referable to the variety ***binotatus*** Knight (1917*b*, p. 635).

MALE.—Length 5.50, width 2.08. Second antennal segment, length 2.05, pale yellowish, apical one-third fuscous to black. Margins of scutellum usually brownish; cuneus pale; legs greenish yellow; hind femora with two pale, fuscous annuli near apices; genital claspers distinctive, fig. 164.

KNOWN DISTRIBUTION.—Illinois, Minnesota, New Jersey, New York, Ohio, Ontario, Wisconsin.

Illinois Record.—NORTHERN ILLINOIS: July, 1 ♂.

Neolygus ostryae Knight

Lygus (*Neolygus*) *ostryae* Knight (1917*b*, p. 635).

MALE.—Length 5.80, width 2.36. Head width 1.05, vertex 0.37. Rostrum, length 2.08, reaching posterior margins of hind coxae. Antennae, first segment, length 0.74; second, 2.25, yellowish, apex fuscous; third, 1.25, yellowish with apical half slightly infuscated; fourth, 0.71, infuscated. Pronotum, length 1.00, width at base 1.85. Deep yellowish brown in color; embolium and basal half of corium pale yellowish; clavus and apical half of corium light brown to dark brown; cuneus almost colorless, tinged with yellowish. Genital claspers as in fig. 164.

FEMALE.—Length 6.00, width 2.40; similar to male in coloration, but slightly larger and more robust.

HOST PLANT.—Hop hornbeam (*Ostrya virginiana*).

KNOWN DISTRIBUTION.—Illinois, Massachusetts, New York, Ontario, Vermont.

Illinois Record. — NORTH EVANSTON: Aug. 20, 1905, Gerhard & Wolcott, 1 ♀, FM.

Neolygus carpini Knight

Neolygus carpini Knight (1939*a*, p. 21).

MALE.—Length 4.70, width 2.00. Head width 0.99, vertex 0.35. Rostrum yellowish, apex brownish, length 1.90, extending slightly beyond hind margins of posterior coxae. Antennae with first segment pale, second pale with apical one-third black, third yellowish, fuscous apically, fourth fuscous. Pronotum yellowish green, tinged with brown, without definite streaks or vittae.

Scutellum yellowish brown, scarcely darker at sides. Hemelytra translucent, yellowish, with clavus evenly shaded with brownish; apical area of corium dark brown; cuneus uniformly translucent, scarcely tinged with yellow; membrane and veins rather uniformly fuscous brown. Venter of body pale to yellowish, a fuscous band along lateral margins. Fuscous band also extending across pleura of thorax. Legs yellowish to brown; femora uniformly brownish, without bands, apices paler; tibiae pale yellowish, spines brown; tarsi brownish, apices fuscous.

FEMALE.—Length 5.00, width 2.16. More robust than male but very similar in color and pubescence.

HOST PLANT. — Hornbeam (*Carpinus caroliniana*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota.

Illinois Record. — DOLSON: June 14, 1933, Frison & Ross, 1 ♂.

Dichrooscytus Fieber

KEY TO SPECIES

1. Length less than 4.00 2
   Length 4.80 or greater 3
2. Width of vertex greater than length of first antennal segment; hemelytra reddish; length 3.50–3.70 .... **tinctipennis,** p. 165
   Vertex narrower, its width less than length of first antennal segment; dorsum uniformly green; length 3.20–3.40 .... **viridicans,** p. 165
3. Paracuneus pale to white; length of first antennal segment less than width of vertex; length 4.80–5.30... .... **suspectus,** p. 166
   Paracuneus reddish; length of first antennal segment equal to or greater than width of vertex; length 5.50–5.80 .... **rufipennis,** p. 166

Dichrooscytus tinctipennis Knight

Dichrooscytus elegans Knight (1923*d*, p. 597), *not* Uhler.

Dichrooscytus tinctipennis Knight (1927*b*, p. 15).

MALE.—Length 3.70, width 1.50. Head width 0.83, vertex 0.36. Rostrum, length 1.18, scarcely attaining posterior margins of hind coxae. Antennae, first segment, length 0.33, less than width of vertex; second 1.36; third, 0.50; fourth, 0.42. **Pronotum,** length 0.64, width at base, 1.18. **Body** clothed with soft, brownish, simple pubescence; on embolium and legs pubescence pale brown or yellowish. General coloration yellowish green, more distinctly green on pronotum and tibiae; corium, clavus, and inner apical half of cuneus, reddish; base and outer margin of cuneus paler. Membrane uniformly light fuscous, veins reddish; an opaque, white, callous mark bordering apical angle of larger areole.

FEMALE.—Length 3.60, width 1.60. Slightly more robust than male, but very similar in pubescence and coloration.

HOST PLANTS.—Red cedar (*Juniperus virginiana*) and arbor vitae (*Thuja occidentalis*).

KNOWN DISTRIBUTION.—District of Columbia, Georgia, Illinois, Iowa, Kansas, Maryland, Minnesota, Mississippi, New Jersey, New York, Ohio, Virginia.

Illinois Records.—CAVE-IN-ROCK: Oct. 2, 1934, Frison & Ross, 1 ♂, 3 ♀. MUNCIE: Sept. 20, 1935, Frison & Mohr, 1 ♀.

Dichrooscytus viridicans Knight

Dichrooscytus viridicans Knight (1918*d*, p. 114).

MALE.—Length 3.20, width 1.25. Head width 0.75, vertex 0.26. Rostrum, length 0.95, just attaining posterior margins of hind

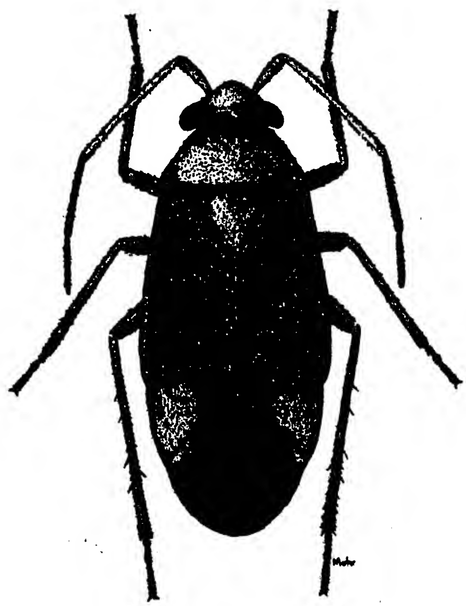


Fig. 166.—*Dichrooscytus viridicans,* ♀.

coxae. Antennae, first segment, length 0.32; second, 1.22; third, 0.56; fourth, 0.38. Pronotum, length 0.56, width at base 1.03, with black, conspicuous pubescence. General color bright green; head, coxae and femora often becoming pale to brownish; cuneus green, apical halves of margins reddish; membrane fuscous, cell veins sometimes reddish.

FEMALE.—Fig. 166. Length 3.30, width 1.40; slightly more robust than male, but not differing in coloration.

HOST PLANTS.—Red cedar (*Juniperus virginiana*) and arbor vitae (*Thuja occidentalis*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Indiana, Iowa, Minnesota, Mississippi, New York, Ohio.

Illinois Records. — Seventy-one males and 101 females, taken May 27 to Aug. 28, are from Antioch, Apple River Canyon State Park, Elizabethtown, Ernst, Freeport, Galena, Golconda, Grandview, Grayville, Hillsboro, Kampsville, Keithsburg, Lake Villa, Monticello, Oquawka, Starved Rock State Park, Urbana, White Pines Forest State Park.

Dichrooscytus suspectus Reuter

Dichrooscytus suspectus Reuter (1909, p. 37).

Not yet collected in Illinois, but should occur here. Known from Connecticut, Colorado, District of Columbia, Indiana, Maine, Maryland, Massachusetts, New Jersey, New York. Its host plants are pines (*Pinus resinosa* and *P. virginiana*).

Dichrooscytus rufipennis (Fallen)

Lygaeus rufipennis Fallen (1807, p. 84).

A European species known from New York; may have been imported with the Scotch pine (*Pinus sylvestris*), on which it feeds. Not yet taken in Illinois.

Polymerus Hahn

KEY TO SPECIES

1. Rostrum reaching hind coxae, or slightly beyond 2
   Rostrum not reaching hind coxae.... 4
2. Rostrum scarcely attaining hind margins of posterior coxae; dorsum black and pale brown; femora with apical halves fulvous, tibiae pale... ....**nigropallidus**, p. 167
   Rostrum reaching slightly beyond posterior coxae; body yellowish brown, with darkened areas; cuneus usually red, rarely paler.......... 3
3. Hemelytra mostly yellowish........ ....**basalis** var. **basalis**, p. 167
   Hemelytra mostly very dark brown, almost black........................ ....**basalis** var. **fuscatus**, p. 167
4. Rostrum reaching beyond anterior margins of middle coxae.......... 5
   Rostrum not reaching posterior margin of mesosternum.............. 6
5. Rostrum attaining hind margins of middle coxae; dorsum black, narrow area at apex of cuneus and slender line on either side of fracture pale; tibiae uniformly black...... ....**proximus**, p. 168
   Rostrum just attaining middle of intermediate coxae; dorsum black and pale brown; tip of scutellum and basal angle of corium pale; cuneus yellowish, red and black.......... **unifasciatus** var. **lateralis**, p. 167
6. Rostrum nearly attaining posterior margin of mesosternum.......... 7
   Rostrum not reaching beyond middle of mesosternum................. 8
7. Legs rather uniformly reddish yellow, but hind femora with a small group of fuscous points on anterior face at middle of apical half; cuneus with outer edge pale brown............ ....**punctipes**, p. 169
   Tibiae black, femora black on apical half of dorsal aspect; cuneus uniformly red orange.....**illini**, p. 168
8. Tibiae reddish yellow or with broad, pale areas...................... 9
   Tibiae black, rarely with some yellowish..........................12
9. Legs mostly red, with apical one-third of femora black; tibiae yellowish, with apices and variable basal area black; second antennal segment yellowish with apex very dark brown...........**venustus**, p. 170
   Legs orange yellow or fulvous.......10
10. Hemelytra uniformly black; length of second antennal segment equal to width of pronotum at posterior margin...........**nubilipes**, p. 170
    Cuneus and embolium of hemelytra pale or fulvous.................11

11. Pubescence on dorsum deep golden; tibiae without black spot at base........................**fulvipes**, p. 170
    Pubescence on dorsum silvery white; tibiae with black spot at base.......................**severini**, p. 170
12. Rostrum scarcely attaining hind margins of front coxae................13
    Rostrum reaching behind posterior margins of front coxae, or nearly to middle of mesosternum........14
13. Hemelytra uniformly black; dorsum clothed with silvery, silky pubescence............**gerhardi**, p. 171
    Hemelytra with embolium and edge of cuneus pale; dorsum clothed with golden, silky pubescence........................**brevirostris**, p. 170
14. Cuneus black; second antennal segment of male as thick as first segment; coxae yellow in both sexes; dorsum black with scutellum and hemelytra clothed chiefly with black pubescence.........**opacus**, p. 170
    Cuneus yellowish or red............15
15. Embolium black; cuneus orange; coxae of male black, of female yellow; dorsum clothed with silvery, silky pubescence..**venaticus**, p. 169
    Embolium pale brown to red........16
16. Femora deep red, only narrow band at apices black; tarsi black; embolium and cuneus deep red.........................**chrysopsis**, p. 171
    Femora deep yellow, apical one-third black, a pale fascia showing on anterior aspect; tarsi mostly yellow, with apical segment and claws black; embolium pale brown to yellow; cuneus orange.........................**flavocostatus**, p. 168

Polymerus basalis (Reuter)

Poeciloscytus basalis Reuter (1876, p. 73).

ADULTS.—Length 3.70–4.80, width 1.70–2.30. General color pale brown to yellowish, darkened with fuscous and black; hemelytra mostly yellowish, with clavus and apical half of corium chiefly fuscous; scutellum black, variable area at apex not so dark; cuneus red; sometimes embolium and legs tinged with reddish; posterior femora with two subapical fuscous bands; dorsum clothed with silvery, silky pubescence that appears golden yellow in certain lights. A very dark form of this species, variety *fuscatus* Knight (1926*f*, p. 167), has not been taken in Illinois.

FOOD PLANTS.—Dog fennel (*Anthemis cotula*); Illinois specimens were collected also on plantain (*Plantago aristata*), daisy (*Chrysanthemum* sp.), sunflower (*Helianthus* sp.), oak (*Quercus* sp.), tickweed (*Coreopsis* sp.); the oak record was certainly a "sitting" record.

KNOWN DISTRIBUTION.—Common in the eastern United States.

Illinois Records.—Two hundred ten males and 176 females, taken May 18 to Oct. 12, are from Albion, Algonquin, Alton, Antioch, Bloomington, Champaign, Chicago, Darwin, Delavan, Dubois, Elizabethtown, Elmira, Farmer City, Freeport, Galesburg, Grand Tower, Grayville, Herod, Karnak, Lawrenceville, McHenry, Metropolis, Monticello, Mount Carmel, Muncie, Paxton, Rockton, Savanna, Seymour, Shawneetown, Springfield, Starved Rock State Park, Urbana, West Union.

Polymerus nigropallidus Knight

Polymerus nigropallidus Knight (1923*d*, p. 599).

Known only from New Jersey.

Polymerus unifasciatus (Fabricius)

Lygaeus unifasciatus Fabricius (1794, p. 178).

MALE.—Length 5.60, width 2.60. Head width 1.04, vertex 0.47. Rostrum, length 1.56, reaching to middle of intermediate coxae. Antennae, first segment, length 0.56; second, 2.08, black, with basal half dusky brown; third, 0.82; fourth, 0.78. Pronotum, length 1.04, width at base 1.86. Clothed with golden, sericeous, tomentose pubescence, intermixed with blackish hairs. Ground color black; apex of scutellum, basal angle of corium, anal ridge and area at inner angle of corium, apex of embolium and area of corium bordering cuneus, base and apex of cuneus, tibiae, apical one-third of front and middle femora, pale to testaceous; cuneus with inner half red, outer margin black except at base and apex; membrane fuscous, veins and central area less dark; a small clear spot bordering apex of cuneus.

FEMALE.—Length 5.20, width 2.65; very similar to male in color and pubescence.

All North American specimens of this species are referable to the variety ***lateralis*** Hahn (1834, p. 85). The typical ***unifasciatus*** has the pale areas broader than does ***unifasciatus lateralis***; the embolium and corium of this variety are pale brown except for a small fuscous patch on the apical area of the corium.

FOOD PLANT.—Northern bedstraw (***Galium boreale***).

KNOWN DISTRIBUTION.—This is a European species, now known from Alberta, British Columbia, Colorado, Illinois, Iowa, Maine, Minnesota, New York, North Dakota, Nova Scotia, Quebec. Blatchley (1926*b*, p. 737) records this from Champaign, Ill., June 14, at light, under the name ***Polymerus unifasciatus*** (Fabricius). Specimens of the typical form from North America have not been seen by the writer.

Polymerus flavocostatus Knight

Polymerus flavocostatus Knight (1926*f*, p. 165).

FEMALE.—Length 5.00, width 2.30. Head width 1.06, vertex 0.54. Rostrum, length 1.11, extending slightly beyond anterior coxae, or to middle of mesosternum; first and second segments chiefly yellow. Antennae black, with third segment yellowish; first segment, length 0.51; second, 1.80; third, 0.86. Pronotum, length 1.02, width at base 1.70.

MALE.—Length 5.70, width 2.30. Head width 1.06, vertex 0.46. Antennae, first segment, length 0.53; second, 1.86. Hemelytra colored as in female; coxae orange yellow, or dusky only at base, similar to female.

FOOD PLANT.—Goldenrod (***Solidago*** sp.).

KNOWN DISTRIBUTION.—Illinois, Iowa, Missouri, Nebraska, North Dakota.

Illinois Records. — CHAMPAIGN: June 15, 1888, C. A. Hart, 1 ♂. GALESBURG: June 18, 1893, 1 ♂. OAKWOOD: June 14, 1930, T. H. Frison, on ***Solidago*** sp., 1 ♂, 1 ♀. URBANA: June 17, 1889, Marten, 1 ♀; June 19, 1889, C. A. Hart, 1 ♂. WEST PULLMAN: July 30, 1905, W. J. Gerhard, 1 ♀, FM.

Polymerus illini new species

This differs from ***flavocostatus*** Knight by the longer rostrum, and from ***punctipes*** Knight by the black tibiae, the partly black femora and the red orange cuneus.

MALE.—Length 4.85, width 2.50. Head width 1.18, vertex 0.44; black, a glabrous, pale spot either side of vertex. Rostrum, length 1.43, just attaining posterior margin of mesosternum. Antennae black with last two segments yellow; first segment, length 0.44, thickness 0.15; second, length 2.29, thickness 0.15, cylindrical; third, length 0.65; fourth, 0.62. Pronotum, length 1.17, width at base 2.03; black, narrow basal and ventral edge pale. Clothed with silvery, sericeous pubescence intermixed on hemelytra with simple, black pubescence. General color black, embolium pale, cuneus and tip of embolium orange colored; membrane black, narrow pale area bordering cuneus; veins yellowish. Tibiae black, slightly pale near base; femora orange colored, apical half black on dorsal aspect, dark color broken by an incomplete annulus of orange which does not cross dorsal surface; coxae pale to orange, infuscated at base; tarsi yellow, apical segment and claws black.

FEMALE.—Length 5.50, width 2.77. Head width 1.22, vertex 0.56. Antennae, first segment, length 0.45, width 0.16; second, 2.08, thickness 0.10; third, 0.77; fourth, 0.78. Pronotum, length 1.21, width at base 2.25. More robust than male, but very similar in coloration and pubescence.

Holotype, male.—Oak Lawn, Ill.: July 1, 1935, DeLong & Ross.

Allotype, female.—Onarga, Ill.: June 8, 1933, Mohr & Townsend.

Paratypes.—ILLINOIS.—Same data as for holotype, 1 ♀; NORTHERN ILLINOIS: 2 ♂, 1 ♀.

Polymerus proximus Knight

Polymerus proximus Knight (1923*d*, p. 601).

This is closely related to ***nigritus*** (Fallen), but may be distinguished from it by the uniformly dark tibiae; the length of the first antennal segment is equal to the width of the vertex, while in ***nigritus*** the length of the first segment is less than the width of the vertex.

MALE.—Length 5.30, width 2.70. Head mostly black with a yellow spot on either side of vertex near eye. Rostrum barely attaining hind margins of middle coxae. Antennae, first segment black; second very dark brown, black at base; third dark brown; fourth black. Pronotum with posterior half of disk strongly convex, transversely wrinkled, uniformly black, slightly

shining; clothed with yellowish, sericeous pubescence. Scutellum deep black, slender area at apex yellowish. Sternum and pleura black; ostiolar peritreme pale brown to yellowish. Hemelytra black; slender area at tip of embolium, and narrow areas at base and apex of cuneus, pale; slightly shining, clothed with intermixed yellowish and black pubescence; membrane and veins uniformly dark fuscous. Legs usually uniformly black; in paler forms, tibiae uniformly very dark brown, but never with indication of annulations. Venter uniformly black, clothed with pale brown to yellowish pubescence.

FEMALE.—Length 5.30, width 2.80; emboliar margins more strongly arcuate than in male, but general coloration similar.

HOST PLANT.—Bedstraw (*Galium aparine*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, Ohio, Ontario, Pennsylvania.

Illinois Record.—ROCK CITY: May 30, 1938, Mohr & Burks, 2 ♂.

Polymerus venaticus (Uhler)

Poeciloscytus venaticus Uhler (1872, p. 414).

MALE.—Length 5.90, width 2.30. Head width 1.04, vertex 0.46. Rostrum, length 1.09, just attaining middle of sternum; piceous, only slightly paler at joints. Antennae, second segment, length 2.31, cylindrical, not equal in thickness to first segment. Hemelytra elongate, tip of abdomen attaining middle of cuneus, emboliar margins very slightly arcuate; black, moderately shining; thickly clothed with sericeous, pale pubescence, a few black hairs on embolium and cuneus; cuneus fulvous or reddish. Legs black, with basal halves of hind and middle femora, anterior face of front femora except at apex, and two basal segments of tarsi, yellow.

FEMALE.—Length 5.00, width 2.57; emboliar margins strongly arcuate; shorter, more ovate and robust than male; coloration very similar to that of male, but coxae always yellowish except for spot at base.

HOST PLANT.—Goldenrod (*Solidago altissima*).

KNOWN DISTRIBUTION.—Alberta, British Columbia, Colorado, Connecticut, District of Columbia, Idaho, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New York, North Dakota, Ohio, Ontario, Pennsylvania, Quebec, Vermont.

Illinois Records.—Eleven males and 24 females, taken May 17 to July 4, are from Antioch, Champaign, Cypress, Elizabethtown, Freeport, Galena, Oakwood, Odin, Palos Park, St. Anne, Urbana.

Polymerus punctipes Knight

Polymerus punctipes Knight (1923*d*, p. 602).

MALE.—Length 4.60, width 2.00. Head width 0.97, vertex 0.47; head black, with a yellow spot on either side of vertex at border of eye; pubescence yellowish. Rostrum, length 1.23, almost attaining hind margin of mesosternum, yellowish, apex black. Antennae, first segment, length 0.51, black, narrow yellowish area at base; second, 1.85, nearly cylindrical, slightly thicker at middle, nearly equal in thickness to first segment, black, clothed with mixed black and pale pubescence; third, 0.66, yellowish, with dusky tinge; fourth, 0.80, dusky. Pronotum, length 1.00, width at base 1.70; black, slightly shining, disk transversely rugulose; clothed with pale and yellowish, sericeous pubescence. Scutellum black, transversely rugulose; clothed with yellowish pubescence, more sericeous on basal angles. Sternum and pleura black; ostiolar peritreme yellow, becoming dusky on anterior lobe. Hemelytra, with emboliar margins slightly arcuate on apical half; black; embolium and outer margin of cuneus yellowish or fulvous; surface scabriculous, slightly shining, clothed with golden, sericeous pubescence intermixed with darker hairs. Membrane rather uniformly fusco-brownish, a small, nearly clear spot bordering apex of cuneus, veins yellowish. Legs fulvous, with spot at apices of femora and apical segment of each tarsus black; hind femora with a group of from two to five fuscous points on anterior face at middle of apical half, a prominent hair rising from each of the two lower points; pubescence pale brown to yellowish, black on apical halves of femora. Venter black, clothed with pale brown to yellowish pubescense.

FEMALE.—Length 5.20, width 2.40; emboliar margins strongly arcuate on apical half; pubescence and color similar to those of male. Rostrum, length 1.31, nearly attaining hind margin of sternum.

FOOD PLANT.—Loosestrife (*Lysimachia quadrifolia*).

KNOWN DISTRIBUTION.—District of Columbia, Florida, Georgia, Illinois, Iowa,

Maine, Maryland, Minnesota, New York, Ohio, Ontario, Quebec.

Illinois Records.—Twelve males and 19 females, taken May 21 to June 24, are from Dolson, Dubois, Elizabethtown, Golconda, Herod, Mound City, Mount Carmel, Oakwood, Pulaski.

Polymerus fulvipes Knight

Polymerus fulvipes Knight (1923*d*, p. 603).

Known from Connecticut, Massachusetts, New York, North Carolina, Pennsylvania. Not yet collected in Illinois.

Polymerus severini Knight

Polymerus severini Knight (1925, p. 247).

No Illinois specimens; known from Alberta, Minnesota, South Dakota.

Polymerus nubilipes Knight

Polymerus nubilipes Knight (1925, p. 248).

Known only from Minnesota and Wisconsin; not yet taken in Illinois.

Polymerus opacus Knight

Polymerus opacus Knight (1923*d*, p. 604).

Not taken in Illinois; known from Maine, Ontario, New York, Vermont. Feeds on aster (*Aster umbellatus*).

Polymerus venustus Knight

Polymerus venustus Knight (1923*d*, p. 605).

MALE.—Length 5.20, width 2.30. Head width 1.01, vertex 0.38; head black; a yellow spot on either side of vertex bordering eye; lower margin of jugum and upper margin of lorum red; clothed with sericeous, pale pubescence. Rostrum, length 1.14, scarcely exceeding posterior margins of front coxae, piceous, paler at joints. Antennae, first segment, length 0.81, black, unusually long and thick (0.15 thick); second, 2.06, cylindrical, thickness 0.07, yellowish, apical one-third black, pubescence same color as surface beneath; third, 1.02, slender, yellowish to fuscous, darker apically; fourth, 1.03, blackish. Pronotum, length 1.03, width 1.74; surface minutely granulate and transversely wrinkled; clothed with yellowish to golden, silky pubescence; black, lower pleural margin with a slender reddish area. Scutellum black, surface and pubescence as on pronotal disk. Sternum and pleura black; ostiolar peritreme yellowish to reddish. Hemelytra with emboliar margins moderately arcuate; black, opaque, surface rather irregularly roughened, somewhat scabriculous; clothed with golden and dusky sericeous pubescence. Membrane uniformly dark fuscous; area bordering apex of cuneus slightly paler, veins yellowish. Legs with coxae and basal half of femora deep, translucent red; lateral areas of coxae, with apex of front pair also, becoming fuscous; apical one-half to one-third of femora black, blackish cloud formed on anterior face of front pair near base; tibiae yellowish to fulvous, basal one-third and apices black; tarsi yellowish, apical half of third segment fuscous. Venter black, clothed with sericeous, silvery pubescence; genital segment with simple, dusky yellowish hairs.

FEMALE.—Length 5.70, width 2.60. Emboliar margins more strongly arcuate apically. More robust than male, but very similar in coloration. First antennal segment as thick as that of male, but second segment slightly more slender.

HABITS.—Collected on willow (*Salix* sp.).

KNOWN DISTRIBUTION. — Florida, Illinois, Michigan, North Carolina, Ohio, South Carolina, Virginia.

Illinois Records.—GOLCONDA: June 22, 1932, on *Salix* sp., Ross, Dozier & Park, 1 ♂, 1 ♀. PULASKI: May 28, 1909, cypress swamp, 1 ♂.

Polymerus brevirostris Knight

Polymerus brevirostris Knight (1925, p. 246).

MALE.—Length 4.50, width 2.20. Head width 0.97, vertex 0.43. Rostrum, length 0.88, not reaching hind margins of front coxae, reddish to fuscous. Antennae, first segment, length 0.46, thickness 0.14, black; second, 1.74, thickness 0.11, cylindrical, slightly constricted near base; black; third, 0.71, orange yellow, fuscous apically; fourth, 0.93, fuscous, yellowish at base. Pronotum, length 0.96, width at base 1.80; basal margin with a slender yellowish area; xyphus reddish. Body clothed with golden yellow, sericeous pubescence, silvery beneath, this pubescence intermixed with pale and fuscous, simple hairs; femora with pale pubescence. General color black; embolium and usually slender outer margin of cuneus yellowish; membrane black, veins yellowish. Legs orange to red; tibiae, tarsi and apices

of femora black; hind femora with indication of a subapical, fuscous band on anterior aspect.

FEMALE.—Length 5.00, width 2.60. Very similar to male in pubescence and coloration.

KNOWN DISTRIBUTION.—Illinois, Manitoba, Michigan, Minnesota, North Dakota, South Dakota, Wisconsin.

Illinois Record.—GALESBURG: June 28, 1893, 1 ♂, 2 ♀.

Polymerus chrysopsis Knight

Polymerus chrysopsis Knight (1925, p. 245).

MALE.—Length 5.70, width 3.60. Head width 1.17, vertex 0.48; head black, with a rounded, yellowish spot on either side of vertex near eye. Rostrum, length 1.24, reaching slightly beyond middle of mesosternum; blackish; first and second segments more or less reddish. Antennae black, clothed with short, mixed pale and fuscous pubescence; first segment, length 0.45, thickness 0.14; second, length 2.06, cylindrical, thickness 0.12; third, length 0.66; fourth, length 0.63. Pronotum, length 1.17, width at base 2.06. Body clothed with silvery white pubescence intermixed with suberect, pale yellowish pubescence. General color black, moderately shining, with embolium and variable area at apex of corium and cuneus, blood red; coxae and femora red; apices of femora and tibiae black; trochanters and extreme bases of coxae sometimes fuscous; posterior femora often with a black patch on dorsal surface before black apex, also two small dots of black on ventral aspect.

FEMALE.—Length 5.50, width 2.80. Very similar to male in pubescence and coloration. Antennae black, last two segments dark brownish.

HOST PLANT.—Golden aster (*Chrysopsis villosa*).

This is the most beautiful species of *Polymerus*, the bright red of the embolium, cuneus and femora, standing in brilliant contrast with the black body. Strange to say, the contrasting red and black colors make the insect difficult to see when it is on its host plant. When disturbed, the adult bug usually rushes to the base of a leaf petiole, where it clasps its legs about the reddish stem of the plant in such a way that the black body with its covering of silvery pubescence suggests, at first glance, a bud in the leaf axil of the golden aster. Many other mirids are so colored as to be similarly inconspicuous when they are on their normal host plants.

KNOWN DISTRIBUTION.—Illinois, Iowa, Manitoba, Minnesota, North Dakota, South Dakota.

Illinois Record.—ALDRIDGE: May 8, 1932, H. L. Dozier, 1 ♂.

Polymerus gerhardi Knight

Polymerus gerhardi Knight (1923*d*, p. 606).

FEMALE.—Length 6.40, width 2.80. Head width 1.16, vertex 0.51; head black, vertex pale on either side; clothed with sericeous, white pubescence. Rostrum, length 1.08, not attaining hind margins of front coxae, piceous, basal segment and joints reddish. Antennae, first segment, length 0.64, thickness 0.14, black; second, 2.03, thickness 0.09, cylindrical, black, with rather closely set, black pubescence; third, 0.96, fusco-brownish; fourth, 0.88, fuscous. Pronotum, length 1.24, width at base 2.14; black, scarcely shining, rather irregularly rugulose; thickly clothed with sericeous, white pubescence; margins of xyphus, and narrow area along lower margins of pleura, yellowish. Scutellum black, pubescent as on pronotal disk. Sternum and pleura black; ostiolar peritreme yellowish. Emboliar margins moderately arcuate. Hemelytra black, thickly clothed with sericeous, white pubescence intermixed with more erect, simple, black hairs. Membrane and veins uniformly very dark brown, slightly paler bordering apex of cuneus. Legs with femora deep red; coxae tending toward yellowish or orange; tips of femora, tibiae, and tarsi, black; tibiae unusually thick, 0.17; spines and pubescence also black. Venter black, thickly clothed with sericeous, white pubescence intermixed with more nearly erect, dark hairs.

MALE.—Length 4.70, width 2.00. Antennae, first segment, length 0.52; second, 2.03, thickness 0.13; third, length 0.82; fourth, length 0.86. Smaller than female, but very similar in pubescence and coloration.

KNOWN DISTRIBUTION.—Described originally from specimens from Lake County, Indiana, and Texas. Since being described, this species has also been collected in Illinois, Mississippi, Oklahoma.

Illinois Records. — ASHLEY: Aug. 7, 1917, 1 ♂, 1 ♀. SAVANNA: June 29, 1935, DeLong & Ross, 1 ♂.

Poecilocapsus Reuter

Poecilocapsus lineatus (Fabricius)

Four-Lined Plant Bug

Lygaeus lineatus Fabricius (1798, p. 541).

ADULT. — Fig. 167. Length 7.00–7.50, width 3.50. General color yellow or green yellow, with four black lines on the dorsum; certain specimens have the yellow of the hemeleytra replaced by bright green.

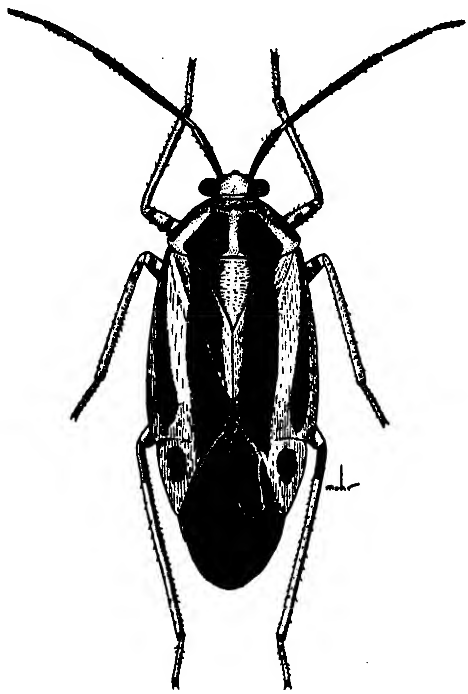


Fig. 167.—*Poecilocapsus lineatus.*

HOST PLANTS.—A large number of herbaceous plants, especially dock (*Rumex* sp.); occasionally becomes a pest on currant bushes (*Ribes* sp.). Large numbers of specimens were collected in Illinois on potato foliage (*Solanum tuberosum*).

KNOWN DISTRIBUTION. — Throughout most of the eastern states and Canada.

Illinois Records.—Sixty-eight males, 129 females and 16 nymphs, taken May 7 to September, are from Algonquin, Anna, Antioch, Beach, Bishop, Bluff Springs, Carbondale, Carlinville, Champaign, Chicago, Clarksville, Cypress, Danville, Edgebrook, Elizabethtown, Fountain Bluff, Frankfort, Freeport, Galena, Galesburg, Giant City State Park, Makanda, Glendon Park, Glen Ellyn, Golconda, Grand Detour, Hardin, Havana, Joliet, Kankakee, Karnak, Manito, Morton Grove, Mount Carmel, Oakwood, Odin, Palos Park, Quincy, Rockford, Rockton, Urbana, Vienna, Villa Ridge, Volo, Warsaw, Waukegan, Willow Springs.

Horcias Distant

KEY TO SPECIES

1. Second antennal segment clavate, its maximum diameter exceeding diameter of first segment; embolium white, cuneus rose colored; see frontispiece .... **illini**, p. 172
   Second antennal segment slightly clavate, but its maximum diameter less than diameter of first segment...... 2
2. Rostrum not surpassing posterior margins of middle coxae; color black with scutellum frequently red...... .... **fallax**, p. 173
   Rostrum extending nearly to posterior margins of hind coxae; color variable .... **dislocatus**, p. 173

Horcias illini new species

This species is allied to *dislocatus* (Say), but differs from it in being smaller, and in having a narrower vertex and more strongly clavate second antennal segment; in color, it is very similar to *dislocatus flavidus* Knight, but the cuneus, calli and head are distinctly reddish; the color pattern apparently is not variable.

MALE.—Frontispiece. Length 5.20, width 2.70. Head width 1.12, vertex 0.43. Rostrum, length 1.95, nearly attaining hind margins of middle coxae. Antennae, first segment, length 0.74, thickness 0.14, black; second, 1.86, thickness 0.15, slender at base (0.07 thick), gradually enlarging to clavate on apical half (0.15 thick), black, densely clothed with short, velvety, yellowish pubescence; third, length 0.82, basal one-fourth widened and pale brown, distal part slender and black; fourth, length 1.04, slender, black, with narrow, tan area at base. Pronotum, length 1.21, width at base 2.04. Surface of body smooth and shining; dorsum with sparse and very fine pubescence. General coloration black and white with lighter areas tinged with reddish. Head yellowish to reddish brown, frons with transverse reddish lines on either side. Pronotum white, a large

quadrate, black area on either side behind calli, leaving median line, lateral margins of disk, and narrow area at basal edge, white; calli and area extending along lateral margins of disk irregularly marked with reddish; propleura with two reddish rays extending parallel to margins of disk. Mesoscutum and scutellum black, median line white. Hemelytra black, broad white area along claval vein; claval suture black only on basal half; embolium, narrow area along radial vein, and wedge-shaped area on inner apical area of corium, white; cuneus reddish, apex blackish, outer basal angle pale. Membrane uniformly dark brown. Ventral surface reddish brown to black, a white line formed on either side of venter; also white mark extending across dorsal half of ostiolar peritreme and side of sternum. Legs pale to dark brown; coxae reddish brown; femora paler on apical half, annulated with yellowish and brown near apices; tibiae pale, tips and knees dark, spines black; tarsi mostly pale, black apically.

FEMALE.—Length 5.80, width 3.10. Head width 1.25, vertex 0.49. Antennae, first segment, length 0.82; second, 2.12, greatest thickness 0.15, clavate as in male; third, length 0.86. Pronotum, length 1.38, width at base 2.42. More robust than male, but very similar in color and pubescence.

Holotype, male. — Dongola, Ill.: May 12, 1916.

Allotype, female. — Same data as for holotype.

Paratypes.—ILLINOIS.—DONGOLA: May 9, 1916, 1 ♂ ; May 12, 1916, 1 ♂ ; May 13, 1916, 1 ♂ , 1 ♀ .

The apparently restricted distribution of this beautiful new species seems worthy of remark. Future collections of specimens will be received with great interest.

Horcias dislocatus (Say)

Capsus dislocatus Say (1832, p. 21).

ADULTS.—Length 6.20, width 3.00. General color of typical form pale rufo-sanguineous. First and second antennal segments, tylus, juga, base of vertex, two wedge-shaped approximate spots on basal half of pronotal disk, scutellum except median line, inner half of clavus, inner apical angles of corium, membrane, pleura, middle and hind coxae, and the venter, black.

This species varies in color from yellow and brown, through red and black, to entirely black. A large number of color combinations of this species have been given varietal names. The Illinois material contains representatives of the following in addition to the typical form: *rubellus* Knight (1923*d*, p. 608), *goniphorus* (Say) (1832, p. 21), *gradus* Knight (1923*d*, p. 609), *residuus* Van Duzee (1912, p. 484), *coccineus* (Emmons) (1854, pl. 30, fig. 2), *limbatellus* (Walker) (1873, p. 93), *affinis* (Reuter) (1876, p. 74), *flavidus* Knight (1923*d*, p. 609), *scutatus* Knight (1923*d*, p. 609), *pallipes* Van Duzee (1912, p. 484), and *nigritus* Reuter (1909, p. 41). Two other varieties, *nigriclavus* Knight (1923*d*, p. 609) and *marginalis* (Reuter) (1876, p. 75) have not been recognized in the material collected here.

FOOD PLANTS. — False Solomon's seal (*Smilacina racemosa*), wild geranium (*Geranium maculatum*), figwort (*Scrophularia leporella*) and occasionally papoose root (*Caulophyllum thalictroides*). A few Illinois specimens were collected also on clover (*Melilotus* sp. and *Trifolium* sp.), oak (*Quercus* sp.) and fleur-de-lis (*Iris* sp.). The different color varieties of this species may occur on any of these food plants.

KNOWN DISTRIBUTION.—Known in its various color forms from Maine westward to Minnesota and southward to Pennsylvania and Texas.

Illinois Records. — One hundred forty males, 155 females and 4 nymphs, collected May 21 to June 30, are from Algonquin, Antioch, Beach, Bloomington, Castle Rock, Champaign, Danville, Dubois, Elizabeth, Frankfort, Freeport, Galesburg, Glendon Park, Glen Ellyn, Grand Detour, Herod, Homer, Joliet, Keithsburg, Le Roy, Manito, Monticello, Mount Carmel, Muncie, Oakwood, Oregon, Palos Park, Pecatonica, Riverdale, St. Joseph, Springfield, Stratford, Urbana, Waukegan, White Heath, White Pines Forest State Park, Willow Springs, Zion.

Horcias fallax Reuter

Horcias fallax Reuter (1909, p. 42).

MALE.—Length 5.10, width 2.10. Head width 1.08, vertex 0.41. Rostrum, length 1.86, just attaining posterior margins of middle coxae. Antennae, first segment, length 0.60, thickness 0.12; second, 1.99, thickness 0.11; third, length 0.80; fourth, length 0.95. Pronotum, length 1.08, width at base 1.86. General color black, shining,

nearly glabrous; scutellum either red or black. Propleura yellowish; rarely anterior half of pronotum yellowish. Legs mostly yellowish with basal halves of middle and hind coxae, tips of tibiae, and apical segment of each tarsus, black; hind femora often with two fuscous annulations just before apex; membrane and veins uniformly dark fuscous or black.

Female.—Length 5.40, width 2.43. Somewhat more robust than male, but very similar in coloration.

Host Plants.—A good series of nymphs and adults were taken on wild gooseberry (*Ribes oxyacanthoides*) in Iowa, May 18 to 25; a few Illinois specimens were collected on willow (*Salix* sp.) and oak (*Quercus* sp.).

Known Distribution.—Illinois, Indiana, Iowa, Ohio, Pennsylvania, Wisconsin.

Illinois Records.—Five males and 12 females, taken May 9 to June 30, are from Algonquin, Dongola, Galesburg, Glen Ellyn, Urbana, White Heath, Willow Springs.

Adelphocoris Reuter

KEY TO SPECIES

Hemelytra dark brown, broad pale area at costal margin, fig. 168; scutellum uniformly dark brown, leng h 6.80–7.40... ....**rapidus,** p. 174

Hemelytra pale, costal edge black; scutellum light with two dark longitudinal lines; usually apical area of corium darkened, fig. 169; length 8.00........ ....**lineolatus,** p. 175

Adelphocoris rapidus (Say)

Capsus rapidus Say (1832, p. 20).

Adults.—Fig. 168. Length 6.80–7.40. General color dark brown. Embolium and outer margin of cuneus light brown; pronotum yellowish brown, basal half of disk usually with two black spots; these spots sometimes fuse to form a transverse black mark.

Host Plants.—Ordinarily breeds on dock (*Rumex* sp.) in the northern states, but may breed on several other plants; Illinois specimens have been collected on clover (*Trifolium* sp. and *Melilotus* sp.) and yarrow (*Achillea* sp.).

Known Distribution.—A common species in the eastern states and those westward to the 100th meridan; farther west it is replaced by *superbus* Uhler, a quite variable species.

Illinois Records.—Two hundred forty-two males, 253 females and 1 nymph, collected May 15 to Nov. 4, are from Albion, Algonquin, Allerton, Alton, Anna, Antioch,

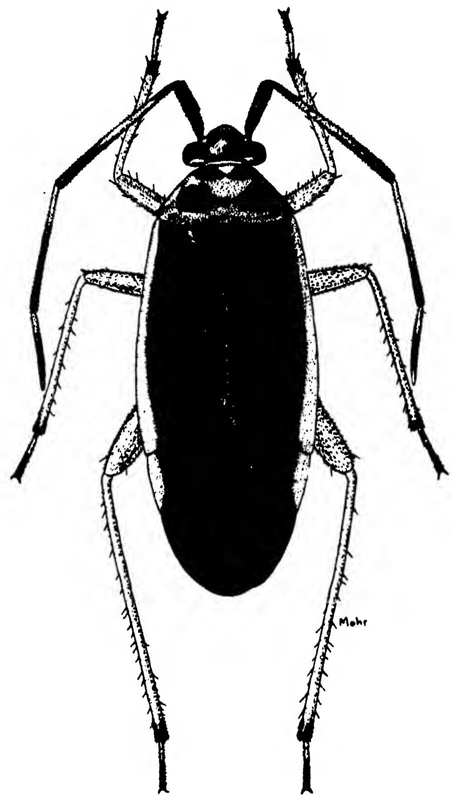


Fig. 168.—*Adelphocoris rapidus.*

Arcola, Aurora, Beardstown, Beach, Bloomington, Blue Island, Bluff Springs, Borton, Browns, Bushnell, Carbondale, Champaign, Chicago, Darwin, Delavan, Dixon, Dolson, Dubois, East St. Louis, Elgin, Elizabethtown, Erie, Fairmount, Farmer City, Fountain Bluff, Freeport, Galena, Galesburg, Giant City State Park, Makanda, Glencoe, Glen Ellyn, Golconda, Grand Detour, Grand Tower, Grand View, Hamilton, Hardin, Hartsburg, Havana, Herod, Hilliary, Hinsdale, Homer Park, Iroquois, Jonesboro, Kankakee, Karnak, Keithsburg, Lawrenceville, Mahomet, Marshall, Mason City, Metropolis, Milford, Monticello, Mound City, Mount Carroll, Muncie, Normal, Oak Lawn, Oakwood, Ogden, Oquawka, Oregon, Palos Park, Pecatonica, Princeton, Pulaski, Rockford, Rockton, St.

Anne, St. Joseph, Savanna, Seaton, Seymour, Shawneetown, Sparta, Springfield, Starved Rock State Park, Sun Lake, Topeka, Ullin, Urbana, Vandalia, Vienna, Virginia, Volo, Ware, Waterman, Watseka, Waukegan, West Union, Willow Springs, York, Zion.

Adelphocoris lineolatus (Goeze)

Alfalfa Plant Bug

Cimex lineolatus Goeze (1778, p. 267).

MALE.—Length 8.00, width 2.80. Head width 1.36, vertex 0.42. Antennae, first segment, length 0.98; second, 2.87; third, 2.20; fourth, 1.30. Pronotum, length 1.30, width at base 2.25. General coloration pale yellowish with a tinge of brown and dusky. Scutellum with two fine, longitudinal fuscous marks on middle; corium usually with a triangular fuscous area on apical half; a fine line along costal edge black; cuneus yellowish; membrane fuscous. Antennae yellowish to brown, apical half darker and usually reddish brown. Legs yellowish; femora with many black dots, anterior aspect with two rows of somewhat larger spots; tibial spines black, without distinct spots at bases. Body clothed with simple, pale yellowish pubescence, legs provided with black pubescence.

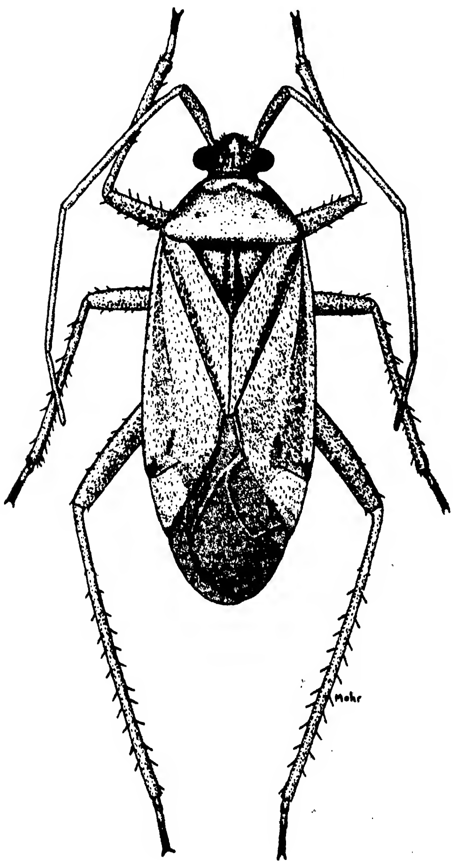


Fig. 169.—*Adelphocoris lineolatus.*

FEMALE.—Fig. 169. Length 7.50, width 2.90. More robust than male and usually somewhat paler in color, but otherwise very similar in form and coloration.

HOST PLANTS.—Alfalfa (*Medicago sativa*) and sweet clover (*Melilotus* sp.); occurs in limited numbers on other leguminous plants; also on many other succulent, herbaceous plants. The bugs prefer to feed on flower buds and newly formed seeds, and may prove a pest where alfalfa and sweet clover are grown for seed.

KNOWN DISTRIBUTION. — A European species first recorded from North America at Cape Breton, Nova Scotia (Knight 1922*a*), and later from Ames, Iowa, where adults were first collected June 18, 1929. They were probably imported as eggs in seeds, as about 700 samples were imported and grown at the agronomy farm at Ames in 1926 and 1927. The spread of this foreign species to surrounding states is indicated to a certain extent by the collection dates placed in parentheses following the names of these states: Iowa (1929), Minnesota (1934), Illinois (1935), Missouri (1935), South Dakota (1935), Nebraska (1936), Wisconsin (1936), Kansas (1939), Manitoba (1939).

Illinois Records. — FREEPORT: June 28, 1935, DeLong & Ross, 2 ♂. RICHMOND: June 25, 1938, at light, Ross & Burks, 1 ♂. SAVANNA: June 29, 1935, DeLong & Ross, 1 ♂.

Stenotus Jakovlev

Stenotus binotatus (Fabricius)

Lygaeus binotatus Fabricius (1794, p. 172).

MALE.—Length 6.00, width 2.00. Chiefly yellowish green below; pronotum with two broad black rays; hemelytra yellowish orange, with two broad, irregular, longitudinal black stripes.

FEMALE.—Length 7.00, width 2.40; yellowish green, pronotum with two prominent black spots on disk, one behind each callus; corium with a longitudinal fuscous stripe.

HOST PLANTS.—Orchard grass (*Dactylis glomerata*) and, to some extent, other grasses; Illinois specimens have been collected on orchard grass and timothy (*Phleum pratense*).

KNOWN DISTRIBUTION. — A European species now known from British Columbia, Illinois, Indiana, Iowa, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Ontario, Oregon, Pennsylvania, Quebec, Tennessee, Wisconsin.

Illinois Records.—One hundred twenty-six males and 158 females, taken June 1 to July 14, are from Antioch, Apple River Canyon State Park, Bureau, Elizabeth, Galena, Hamilton, Hardin, Karnak, Marshall, Mason City, Monticello, Palos Park, Plainview, Putnam, Urbana, Warsaw, Waukegan, Zion.

Paracalocoris Distant

KEY TO SPECIES

1. Hind tibiae thickly clothed with long, erect hairs which obscure tibial spines and are easily confused with them............**scrupeus,** p. 177
   Hind tibiae with shorter and more appressed hairs, especially on inner side; hairs not easily confused with true spines..................... 2
2. Length of first antennal segment as great as or greater than maximum dorsal length of pronotum........ 3
   First antennal segment shorter than pronotum..................... 6
3. Length of first antennal segment less than width of head plus dorsal width of an eye; length 6.00–6.50........ ....**hawleyi,** p. 178
   Length of first antennal segment equal to width of head plus dorsal width of an eye, or greater............ 4
4. Second antennal segment uniformly black.............. **limbus,** p. 178
   Second antennal segment pale yellowish to brown, sometimes dark brown, but never black; general coloration brownish, with minute pale spots..................... 5
5. First antennal segment reddish brown, with pallid spots; gula and genae dark brown.................... ..**pallidulus** var. **pallidulus,** p. 178
   First antennal segment more pallid than brown; gula and genae pallid ..**pallidulus** var. **albigulus,** p. 178
6. Length of first antennal segment equal to or greater than width of head... 7
   Length of first antennal segment less than width of head.............. 9
7. Pronotum and scutellum with three distinct yellowish stripes; first antennal segment black, with few, if any, pale spots.....**trivittis,** p. 178
   Pronotum and scutellum without distinct stripes; first antennal segment pallid, marked with brown, or brown with pallid marks.......... 8
8. Apical half of second antennal segment black or very dark brown; scutellum with narrow, median, yellowish line, this line sometimes obscured by brownish coloration.. ....**evonymi,** p. 178
   Second antennal segment rather uniformly yellowish brown, in darkest specimens with black but only at apex; scutellum with light color irregularly distributed;. brown largely broken by minute, light-colored spots.........**salicis,** p. 177
9. Dorsum dark brown, with several large yellow patches: on apical half of scutellum, apex of clavus, middle of corium, apex of embolium and outer half of corium, and three areas on pronotum............. ....**multisignatus,** p. 180
   Ground color dark brown, light-colored areas taking the form of fine lines and small dots..........10
10. Basal half of second antennal segment yellowish brown, but without narrow white annulus at middle or base................**castus,** p. 178
    Second antennal segment with a narrow white annulus near the middle which separates black area on apical half from brownish basal half.....11
11. Rostrum extending beyond hind coxae ....**celtidis,** p. 179
    Rostrum not extending beyond hind coxae..........................12
12. Second antennal segment dark, with pale annulus at middle only; femora dark at base, apical half with one large and several smaller white spots............**gleditsiae,** p. 180
    Second antennal segment with pale

annulus both near base and at middle; femora with broad, light-colored areas at base and middle........ ....**colon,** p. 180

Paracalocoris scrupeus (Say)

Capsus scrupeus Say (1832, p. 23).

MALE.—Length 6.00, width 2.50. Head, width 1.10, vertex 0.52. Rostrum, length 2.38, reaching to middle of hind coxae. Antennae, first segment, length 1.25; second, 1.95; third, 0.82; fourth, 0.91. Pronotum, length 1.34, width at base 2.08. Varying in color from orange and black, through yellow and brown, to almost uniformly brown or tan.

A large number of color combinations of this species have been given varietal names. Of these, besides the typical form, the following varieties, all described by McAtee (1916), have been taken in Illinois: *delta, ardens, cunealis, par, sordidus, bidens; nubilus, varius, compar, lucidus, percursus, rubidus* and *triops.*

HOST PLANTS.—Most frequently wild grape (*Vitis* sp.), but may occur on cultivated varieties of grape and, occasionally, on other woody plants. Illinois specimens were collected on grape, box elder (*Acer negundo*), willow (*Salix* sp.), hop tree (*Ptelea trifoliata*), hickory (*Carya* sp.), hawthorn (*Crataegus* sp.), dogbane (*Apocynum* sp.) and dogwood (*Cornus* sp.).

Illinois Records.—One hundred males and 150 females, taken May 30 to July 12, are from Algonquin, Antioch, Bureau, Dixon, Dolson, Elizabeth, Elizabethtown, Frankfort, Freeport, Galena, Galesburg, Grand Detour, Harvard, Havana, Joliet, Kampsville, Kankakee, Keithsburg, Kingston, Monticello, Oakwood, Oquawka, Oregon, Palos Park, Putnam, Riverside, Savanna, Urbana, West Union, White Heath, Willow Springs, Zion.

Paracalocoris salicis Knight

Paracalocoris salicis Knight (1926*j*, p. 367).

MALE.—Length 6.00, width 2.50. Head width 1.15, vertex 0.50. Rostrum, length 2.36, nearly attaining hind margins of posterior coxae. Antennae, first segment, length 1.18, slightly greater than width of head; second, 2.22, rather uniformly yellowish brown, somewhat darker at apex; third, 0.89, black, narrow pale area at base. Pronotum, length 1.35, width at base 2.06. Dorsum clothed with short, yellowish pubescence, more golden on clavus, and with a few sericeous hairs on scutellum and clavus. Ground color pale yellowish, more or less clouded with dark brown; pronotal disk brown with several small, pale spots, some

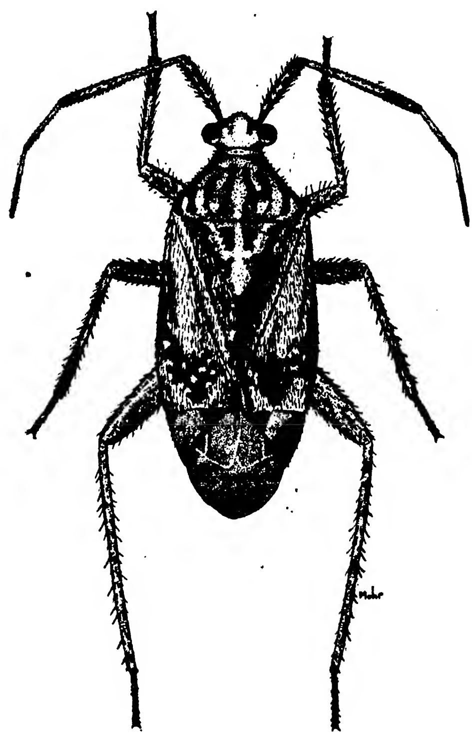


Fig. 170.—*Paracalocoris salicis*, ♀.

of which coalesce behind outer margin of each callus to suggest a ray; pale yellowish median line of pronotum continued on scutellum, where irregular dark color on either side of it is composed of aggregated small dots. Hemelytra medium brown to dark brown, marked with pale dots in longitudinal series, one row along middle of corium, another along radial vein; apex of embolium and inner apical angle of corium with broad, pale areas; clavus with a more or less broad, pale mark along claval vein. Cuneus very light yellow, with inner basal angle, apex, and area extending back along margin of membrane, brownish. Membrane yellowish to brownish, darker at apex and areoles; veins white, brown around smaller areole. Legs tan to yellowish, darkened with brown, this dark color broken by numerous pale dots; basal third of tibiae, band at mid-

dle, and narrow band at apex, dark brown. Venter yellowish, sides with three indistinct, longitudinal, dark lines separated by three indistinct yellow ones.

FEMALE.—Fig. 170. Length 6.40, width 2.60. Head width 1.14, vertex 0.50. Antennae, first segment, length 1.24; second, 2.22; third, 1.00; fourth, 0.98. Very similar to male in pubescence and coloration.

HOST PLANT. — Sandbar willow (*Salix longifolia*).

KNOWN DISTRIBUTION.—Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, Pennsylvania, South Dakota.

Illinois Records. — Twenty-two males and 31 females, taken May 27 to July 26, are from Alton, Bureau, Elizabethtown, Freeport, Golconda, Herod, Kampsville, Lilly, Monticello, Oquawka, Oregon, Palos Park, Pulaski, Rockford, St. Joseph, Savanna, Seymour, West Union, Willow Springs, York.

Paracalocoris hawleyi Knight

Paracalocoris hawleyi Knight (1916*b*, p. 377).

Not taken in Illinois; known from Massachusetts, New York, Ohio. Occurs on cultivated hop (*Hamulus japonicus*).

Paracalocoris limbus McAtee

Paracalocoris limbus McAtee (1916, p. 380).

Not taken in Illinois; known from Georgia, Maryland, Massachusetts, New York, Ohio, Pennsylvania, Virginia.

Paracalocoris pallidulus McAtee

Paracalocoris hawleyi var. *pallidulus* McAtee (1916, p. 380).

Not taken in Illinois; known from Minnesota, New York, North Dakota, Ohio, Ontario; feeds on apple (*Pyrus malus*) and hawthorn (*Crataegus* sp.). The variety *albigulus* Knight (1930*d*, p. 823) is generally lighter in color than the typical form.

Paracalocoris castus McAtee

Paracalocoris colon var. *castus* McAtee (1916, p. 382).

MALE.—Length 5.40, width 2.30. Head width 1.04, vertex 0.45. Rostrum, length 1.95, just reaching to middle of hind coxae. Antennae, first segment, length 0.88, dark brown with a few yellowish spots; second, 2.08, yellowish brown, apical two-fifths and narrow area at base dark brown, without any indication of white annuli; third, 0.75, yellowish, apical half black; fourth, 1.03, fuscous. Pronotum, length 1.21, width at base 1.90. General color dark brown, with a few yellow spots on pronotum, apical area of corium and on cuneus; scutellum with a slender, median yellowish line. Membrane fuscous, with a yellowish spot near tip of cuneus; veins fuscous, pale at apex of larger areole. Dorsum clothed with yellowish to golden, sericeous pubescence intermixed with a lesser amount of simple pubescence. Legs dark brown; femora with rows of small yellowish spots, hind femora each with a large yellowish spot dorsally near middle of apical half; each tibia with a broad, yellowish band at middle and just before apex; tarsi brown to fuscous.

FEMALE.—Length 5.40, width 2.60. Head width 1.11, vertex 0.51. Antennae, first segment, length 1.03; second, 1.99; third, 0.91; fourth, 1.12. Pronotum, length 1.38. width at base 2.12. More robust than male, but very similar in pubescence and coloration.

HOST PLANT.—Virginia creeper (*Psedera quinquefolia*).

KNOWN DISTRIBUTION.—District of Columbia, Florida, Illinois, Iowa, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Ohio, Vermont.

Illinois Records.—ALGONQUIN: June 24, 1894, 1 ♀. ANTIOCH: July 5-7, 1932, T. H. Frison, 1 ♂, 1 ♀. HAVANA: July 12, 1932, Dozier & Park, 1 ♀. WHITE PINES FOREST STATE PARK: July 4, 1932, Dozier & Mohr, 1 ♂.

Paracalocoris trivittis Knight

Paracalocoris trivittatus Knight (1926*j*, p. 371). *Preoccupied.*

Paracalocoris trivittis Knight (1930*d*, p. 812).

Known only from Mississippi.

Paracalocoris evonymi Knight

Paracalocoris evonymi Knight (1930*d*, p. 812).

MALE.—Length 6.10, width 2.70. Head width 1.13, vertex 0.54. Rostrum, length 2.25, reaching to middle of hind coxae, yellow with apex black. Antennae, first segment, length 1.25, pale, with reticulated brown marks and spots; second, 2.25, nar-

row area at base black, bordered by a pale annulus, then yellowish brown to middle, where a slightly paler annulus separates this from the black on apical half; third, 0.97, pale, distal half black; fourth, 1.12, blackish, paler at base. Pronotum, length 1.38, width at base 2.12; dark brown; disk with a few pale spots; median line pale although it may be indistinct near basal margin, basal edge yellowish; discal spots black, inner and outer margins bordered by yellow. Scutellum dark brown, median line with a slender pale mark; small spot near each basal angle, and a few even smaller dots near middle and apex, yellow. Hemelytra dark brown to black; area at inner half of clavus bordering scutellum black; corium with a few vague, yellowish spots; radial vein yellow on basal half. Cuneus mostly dark brown, with outer edge and area extending across middle yellowish; light-colored area on disk appearing more as spots than as uniform color. Membrane dark fuscous to black; a rather large, yellowish spot on margin near apex of cuneus and a smaller one on middle of larger areole; vein at apex of larger areole yellowish. Legs tan, with bases of coxae more or less fuscous and apical halves of femora spotted with brown, this coloration on apical third of hind femora interrupted by a few minute, yellow spots; tibiae each with two brown bands, apices only slightly darkened; tarsi pale, apices black. Venter of thorax dark brown, darker at sides; ventral surface of abdomen yellowish on basal half, sides rather uniformly very dark brown, except on second, or first visible, segment, where two more or less indistinct pale marks occur. Dorsum clothed with yellowish to golden, recumbent, sericeous pubescence intermixed with a few obscure, simple hairs.

FEMALE.—Length 5.80, width 2.80. Head width 1.16, vertex 0.56. Antennae, first segment, length 1.21; second, 2.20; third, 1.00; fourth, 1.12. Pronotum, length 1.35, width at base 2.16. Slightly more robust than male, but very similar in pubescence and coloration.

HOST PLANT.—Waahoo or burning bush (*Evonymus atropurpureus*); a single specimen was taken in this state on box elder (*Acer negundo*); others were taken on redbud (*Cercis canadensis*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Ohio, western New York.

Illinois Records. — ELIZABETHTOWN: May 27-31, 1932, on redbud, H. L. Dozier, 3 ♂. OQUAWKA: June 13, 1932, on *Acer negundo*, H. L. Dozier, 1 ♀.

Paracalocoris celtidis Knight

Paracalocoris celtidis Knight (1930*d*, p. 810).

MALE.—Length 5.70, width 2.60. Head width 1.14, vertex 0.56. Rostrum, length 2.70, extending to fifth abdominal segment, tan to yellowish with last two segments black. Antennae, first segment, length 1.00, dark brown to black, with several small, white, glabrous spots and set with several erect, black setae; second, 2.25, black, with pale annulus at middle; third, 0.91, fuscous to black, yellowish at base; fourth, 0.95, black, with a narrow yellowish area at base. Pronotum, length 1.30, width at base 2.00; disk dark brown to black, with pale spots; calli and areas surrounding discal spots yellow to yellowish brown; area between calli white, this color extending back along median line to base as a white line, basal half of line apparently produced by the joining of several spots. Scutellum brown, with yellowish, more or less confluent spots; median line yellowish, except at apex, but this line joined by so many spots that its outline is largely obscured. Hemelytra black and brown, with minute yellowish spots, these more prominent along radial vein and near apex of embolium. Cuneus largely white due to the numerous and confluent white spots; apex and paracuneus black. Membrane dark fuscous or black, with disk of larger areole, apical half of membrane except large spot bordering apex of larger areole, and spot at middle of outer margin, yellowish. Legs yellow, marked with brown; distal half of femora with black ground color, which is cut into small areas by numerous white spots; hind femora with one much larger white spot on middle of dorsal aspect; tibiae with apex, band at middle, and a broader band at base, brown, the last somewhat broken by white spots; tarsi pale, apices black. Venter dark brown, varied with white and yellowish marks; sides tending toward black, with three rows of obliquely placed, yellow dashes. Dorsum clothed with recumbent, pale to golden yellow, sericeous pubescence, intermixed with less prominent, simple, fus-

cous hairs; femora with several prominent, bristlelike white hairs, much as in *gleditsiae* Knight; tibiae with several yellowish, setose hairs which may be longer than true spines, but these spines much thicker and brown in color.

FEMALE.—Length 6.00, width 2.60. Head width 1.14, vertex 0.56. Antennae, first segment, length 1.04; second, 2.03; third, 0.95; fourth, 1.29. Pronotum, length 1.34, width at base 2.12. Slightly more robust than male, but very similar in pubescence and coloration.

HOST PLANT.—Hackberry trees (*Celtis occidentalis*).

KNOWN DISTRIBUTION. — Illinois and Iowa.

Illinois Records.—ILLINOIS: 1 ♀. URBANA: July 16, 1932, C. O. Mohr, 1 ♀.

Paracalocoris gleditsiae Knight

Paracalocoris gleditsiae Knight (1926*j*, p. 370).

This is allied to *colon* (Say) by key characters and it is distinguished from *colon* by having several prominent, erect, bristlelike hairs on the hind femora; the length of each of these hairs is greater than the thickness of a tibia.

MALE.—Length 5.40, width 2.20. Head width 1.05, vertex 0.47. Rostrum, length 2.04, reaching to middle of hind coxae. Antennae, first segment, length 0.89, dark reddish brown with a few small white dots; second, 1.90, dark brown, with a pale annulus at the middle and a somewhat lighter brown area before annulus; third, 0.81, dark brown to fuscous, paler at base; fourth, 0.83, fuscous, a narrow yellowish area at base. Pronotum, length 1.20, width at base 1.86; dark brown, basal half of disk black, slender area at base yellowish, and with seven or eight pale spots on sub-basal margin, area bordering outer margin of black discal spots, and four short, longitudinal marks between, yellow to white. Scutellum dark brown, with slender line and irregular marks on either side near apex pale. Hemelytra dark brown, somewhat paler at base of corium and apex of clavus; embolium, corium and cuneus with several small, yellowish or white dots. Membrane infuscated, veins about apex of larger areole white. Venter with sides dark brown, each segment with three yellow marks which, taken together, suggest broken, longitudinal lines. Legs reddish brown, irregularly marked with white dots; femora much darker at bases; hind pair with a large white spot on dorsal aspect beginning at middle; tibiae with white band at middle.

FEMALE.—Length 5.80, width 2.70. Head width 1.12, vertex 0.54. Antennae, first segment, length 0.99; second, 1.92; third, 0.75; fourth, 0.78. Pronotum, length 1.30, width at base 2.04. Very similar to male in pubescence and coloration.

HOST PLANT.—Honey locust (*Gleditsia triacanthos*); also collected on black locust (*Robinia pseudoacacia*).

KNOWN DISTRIBUTION. — Illinois, Indiana, Iowa, Ohio.

Illinois Records.—DANVILLE: June 8, 1902, Titus & Kahl, 1 ♂. ELIZABETHTOWN: May 27-31, 1932, on *Robinia pseudoacacia*, H. L. Dozier, 1 ♂, 4 ♀. NEW HOLLAND: May 28, 1936, Mohr & Burks, 3 ♂, 4 ♀; ST. JOSEPH: June 17, 1932, T. H. Frison, 1 ♂.

Paracalocoris multisignatus Reuter

Paracalocoris multisignatus Reuter (1909, p. 40).

Known from District of Columbia, Georgia, Indiana, Maryland, Mississippi, New York, North Carolina, Ohio, Oklahoma, Texas, Virginia. It should eventually be found in southern Illinois. Breeds on wild grape (*Vitis rotundifolia*).

Paracalocoris colon (Say)

Capsus colon Say (1832, p. 25).

ADULTS.—Length 5.80, width 2.50; length of pronotum 1.33. Antennae, first segment, length 1.10, brownish, spotted with yellow, spots more or less confluent, clothed with black semierect hairs which are hardly as long as segment is thick; second, 2.22, narrow area at base and apical one-third black, area between brownish, but with pale annulus bordering black, pubescence fine; third, 0.97, pale to fuscous, becoming darker at apex; fourth, 1.08, pale fuscous, darker at apex. Dorsum pale yellowish to grayish or dark brown, spotted with yellow, in paler specimens brown forming large spots; clothed with pale yellowish to golden pubescence; membrane fuscous, with a spot at middle and on either side near tip of cuneus yellowish. Ventral surface brownish, each segment with two or three longitudinal, yellow marks on sides. Legs yellowish; apical third of femora and two bands on tibiae

brownish, this color spotted with yellow; in dark specimens, hind femora developing a brownish patch on basal half.

FOOD PLANT.—Collected on gooseberry (*Ribes* sp.) in Illinois.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Indiana, Michigan, New Jersey, New York.

Illinois Records.—Eleven males and 8 females, taken May 29 to July 14, are from Anna, Forest City, Hardin, Havana, Keithsburg, Manito, Palos Park, Quincy, White Heath, White Pines Forest State Park.

Garganus Stål

Garganus fusiformis (Say)

Capsus fusiformis Say (1832, p. 24).

MALE.—Fig. 171. Length 5.10, width 1.60. Head width 0.86, vertex 0.30. Rostrum, length 1.86, slightly exceeding posterior margins of hind coxae. Antennae, first segment, length 0.95, orange colored and with short, fuscous pubescence; second, 1.86, fusiform, thickness 0.13, black, thickly clothed with slightly flattened, black hairs; third, 0.99, slender, black, yellowish at base; fourth, 1.00, black. Pronotum, length 0.78, width at base 1.22. General color black; collar, broad area on median line of scutellum, inner margin of clavus, embolium, and outer margin of cuneus, yellowish to white; legs and venter, except genital segment, orange colored.

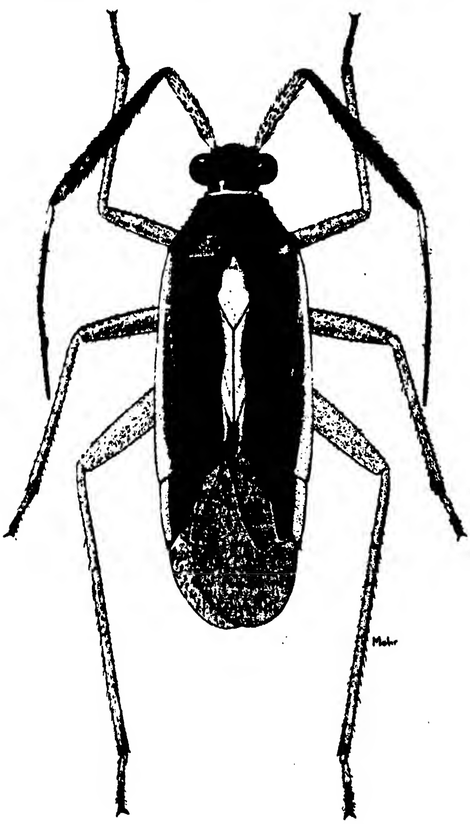


Fig. 171.—*Garganus fusiformis*, ♂.

FEMALE.—Length 5.40, width 1.81. Head width 0.91, vertex 0.36. Antennae, first segment, length 0.86, yellow to orange; second, 1.77, fusiform, greatest thickness 0.17; third, 1.00; fourth, 1.08. Pronotum, length 0.86, width at base 1.35. More robust than male, but very similar in pubescence and coloration.

HOST PLANTS. — Coltsfoot (*Tussilago farfara*); Illinois specimens were taken also on smartweed (*Polygonum* sp.).

KNOWN DISTRIBUTION.—Alabama, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Kansas, Maryland, Massachusetts, Missouri, North Carolina, New Jersey, New York, Ohio, Ontario, Pennsylvania, South Carolina, Tennessee, Virginia.

Illinois Records.—Sixty-six males, 46 females and 1 nymph, taken June 14 to Oct. 6, are from Algonquin, Alto Pass, Browns, Cairo, Carbondale, Carmi, De Soto, Dixon Springs, Dolson, East St. Louis, Elizabeth, Elizabethtown, Galesburg, Grand Tower, Grandview, Herod, Karnak, Metropolis, Milo, Mount Carmel, Normal, Pulaski, Temple Hill, Urbana, West Pullman.

Neurocolpus Reuter

KEY TO SPECIES

1. Length of first antennal segment three-fifths or more length of second segment 2
   Length of first antennal segment not, or only slightly, exceeding one-half length of second segment 3
2. Length of first antennal segment nearly three-fourths length of second segment; tip of rostrum surpassing posterior margins of hind coxae .... **tiliae**, p. 182
   Length of first antennal segment not more than two-thirds length of second segment; tip of rostrum reaching posterior margins of hind coxae .... **nubilus**, p. 182

3. Hind femora pale with apical one-fourth black..........**jessiae,** p. 183
Hind femora fuscous or reddish on basal half..........**rubidus,** p. 183

Neurocolpus nubilus (Say)

Capsus nubilus Say (1832, p. 22).

MALE.—Length 6.50, width 2.50. Head width 1.12, vertex 0.52. Rostrum, length 2.70, just attaining posterior margins of hind coxae. Antennae, first segment, length 1.34, moderately compressed, width 0.28, pale, with irregular brown marks, clothed with prominent, flattened black hairs intermixed with erect, white bristles; second, 2.42, yellowish brown, reddish brown to black on slightly thickened apical one-third; third, 0.88, black, pale at base; fourth, 0.86, blackish. Pronotum, length 1.43, width at base 2.12; pale greenish yellow; disk with irregular brownish marks; basal half clothed with erect, slightly flattened black hairs, intermixed with pale, simple and a few more recumbent, sericeous hairs. Scutellum yellowish, irregularly marked with brown. Hemelytra brownish to fuscous, the darker color broken by minute yellowish dots and irregular spots; cuneus darker at base and apex; membrane fuscous with a pale marginal spot behind cuneus; veins brown, yellowish apically. Legs tan; femora showing brownish markings; hind pair with brownish band at middle of apical half; space before band and at apex, yellowish or white; irregular brownish markings usually breaking paler color; tibiae with band at middle and at apex dark brown or fuscous and with another irregular one of same color near base.

FEMALE.—Length 7.00, width 2.60. More robust than male, but very similar in pubescence and coloration.

HOST PLANT.—Buttonbush (*Cephalanthus occidentalis*); Illinois specimens also were collected on cottonwood (*Populus deltoides*), Kentucky coffee tree (*Gymnocladus dioica*) and willow (*Salix* sp.).

KNOWN DISTRIBUTION.—Common in all the eastern states and southeastern Canada.

Illinois Records.—One hundred twenty-six males and 119 females, taken May 24 to Sept. 2, are from Algonquin, Alton, Antioch, Ashley, Browns, Champaign, Chicago, Decatur, Dolson, Dubois, Duncan Mills, East St. Louis, Elizabethtown, Frankfort, Galena, Grand Tower, Havana, Herod, Horseshoe Lake, Karnak, Keithsburg, Lilly, Monticello, Mound City, Mount Carmel, Muncie, Oakwood, Oregon, Palos Park, Parker, Quincy, Savanna, Seymour, Shawneetown, Urbana, Volo, Wauconda, West Union, Winchester, York.

Neurocolpus tiliae Knight

Neurocolpus tiliae Knight (1934, p. 162).

MALE.—Fig. 172. Length 5.70, width 2.30. Head width 1.00, vertex 0.48. Rostrum, length 2.55, exceeding posterior margins of hind coxae, extending to fourth ventral segment. Antennae, first segment, length 1.43, slightly compressed, greatest width 0.24 near middle, clothed with erect, flattened, black hairs, intermixed with erect, slightly longer, simple, yellowish hairs, orange yellow, irregularly marked with reddish or fuscous dots; second, 2.03, slender, becoming clavate on apical third (width 0.15), pale, thickened part dark red to blackish; third, 0.78, yellowish, apical third black with a reddish cast; fourth, 0.74, fuscous. Pronotum, length 1.25, width at base 1.82, basal margin distinctly sinuate at middle. Dorsal aspect yellowish to orange red, hemelytra with a considerable number of yellowish spots which are larger and, in part,

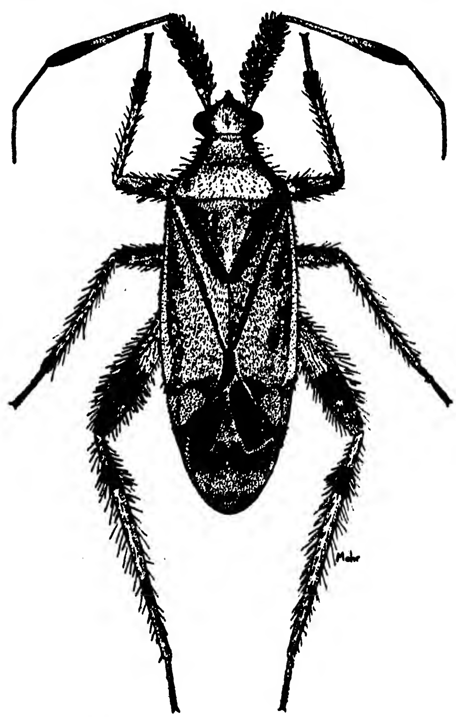


Fig. 172.—*Neurocolpus tiliae*, ♂.

confluent on cuneus; scutellum paler, irregularly marked with dark granulate reticulations; pronotum yellowish, usually darkened by hypodermal reddish granulations; propleura pale; coxal cleft crossed by two irregular dark rays. Membrane fuscous, a rounded spot on either side touching margin; discal spot, and areas bordering cuneus within areoles, less dark. Hemelytra clothed with golden, slightly sericeous, recumbent pubescence, intermixed with some simple, pale to fuscous hairs; pronotum with much longer hairs. Body beneath tan to yellowish; sides of thorax and abdomen darkened with reddish and fuscous; two paler longitudinal lines running through dark color. Legs tan to yellowish; hind femora darkened on apical half with reddish and fuscous and provided with a few flattened, black hairs; tibiae pale to reddish, not distinctly banded.

FEMALE.—Length 5.60, width 2.30. Very similar to male in form and coloration.

HOST PLANT.—Basswood (*Tilia americana*).

KNOWN DISTRIBUTION.—Illinois, Iowa, Minnesota, New York, Ontario.

Illinois Records.—NORTHERN ILLINOIS: 3 ♀. ALGONQUIN: July 17, 1896, 1 ♀. FRANKFORT: June 8, 1933, Mohr & Townsend, 1 ♀. GALESBURG: July 24, 1892, 4 ♀. URBANA: July 4, 1915, on tree trunk, 1 ♀.

Neurocolpus jessiae Knight

Neurocolpus jessiae Knight (1934, p. 163).

MALE.—Length 6.30, width 2.34. Head width 1.08, vertex 0.43. Rostrum, length 2.50, extending nearly to hind margins of posterior coxae. Antennae, first segment, length 1.25, slightly compressed, greatest width (0.22) near middle, the black scalelike hairs only moderately conspicuous, these hairs intermixed with a few more nearly erect, black bristles, this segment very dark brown, closely and irregularly spotted with yellowish; second, 2.64, slender, distal half gradually tapering to become thicker apically, part black, basal half yellowish; third, 1.08, black, yellowish at base; fourth, 1.11, black. Pronotum, length 1.34, width at base 1.95. Dorsum chiefly black, with basal half of cuneus, spots on embolium and scutellum, and more or less broad area on anterior half of pronotum, tan to yellowish; body beneath pallid to yellowish, sides of thorax and venter more or less infuscated. Legs pallid; apical one-fourth of hind femora black; front and middle femora with irregular fuscous areas at apices; tibiae pallid; front and middle pairs with bases, apices, and two narrow rings between, fuscous; hind tibiae with basal one-fourth and broad band just below middle, black; apices fuscous; tarsi yellowish, apical segment largely black.

FEMALE.—Length 6.50, width 2.30. Very similar to male in form and coloration.

HABITS.—Nymphs and adults were collected "from panicles of elder fruit" at Urbana, by C. A. Hart.

KNOWN DISTRIBUTION.—Illinois, Iowa, Massachusetts, Missouri, Mississippi, New York, Ontario, Texas.

Illinois Records.—NORTHERN ILLINOIS: 1 ♂. GALESBURG: 1 ♂; July 27, 1892, 1 ♂, 1 ♀; July 24, 1892, 1 ♀. URBANA: July 20, 1889, from panicles of elder fruit, C. A. Hart, 11 ♂, 16 ♀; July 21, 1889, in forest, C. A. Hart, 1 ♀; July 24, 1889, on elder (*Sambucus* sp.), C. A. Hart, 2 ♂, 9 ♀.

Neurocolpus rubidus Knight

Neurocolpus rubidus Knight (1934, p. 164).

MALE.—Length 6.00, width 2.10. Head width 1.00, vertex 0.41. Rostrum, length 2.30, just attaining posterior margins of hind coxae. Antennae, first segment, length 1.04, compressed, greatest width 0.22 near middle, reddish, irregularly and closely marked with yellowish, usually flattened, black hairs abundant, intermixed with somewhat longer, pale to fuscous, bristlelike hairs; second, 2.16, slender, gradually thickened (width 0.12) on apical half, yellowish, apical half reddish; third, 0.82, fuscous, pale at base; fourth, 0.83, black. Pronotum, length 1.12, width at base 1.73. General coloration reddish, in dark specimens fuscous appearing on hemelytra. Embolium and scutellum with several yellowish spots; membrane dark fuscous, a pale spot on either side at margin; veins dark; apical curve of cubitus reddish. Dorsum clothed with golden, sericeous pubescence intermixed with simple yellowish to fuscous hairs; distinct black hairs on pronotum. Femora reddish; hind pair with a distinct yellowish spot above, slightly beyond middle; tibiae yellowish, two narrow reddish rings on front and middle pair; reddish areas on middle and basal one-fourth of hind pair.

FEMALE.—Length 6.20, width 2.34. Very similar to male in form and coloration.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Kansas, New York, Ohio.

Illinois Record.—NORTHERN ILLINOIS: 2♂, 2♀.

Phytocoris Fallen

KEY TO GROUPS

1. Wing membrane confusedly sprinkled with discolored or dark spots, or with numerous, minute, pale spots; median lobe of male genital structure provided with a flagellum that lacks distinct teeth, fig. 175. **Group I,** p. 184

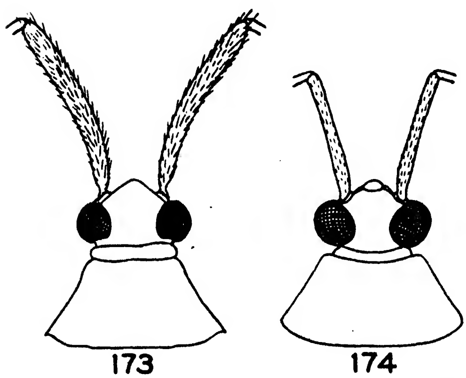


Fig. 173.—Head and first antennal segment of *Phytocoris lasiomerus.*

Fig. 174.—Head and first antennal segment of *Phytocoris conspurcatus.*

Wing membrane marbled, uniformly dark brown or uniformly light colored, never with many minute spots (except perhaps in some forms of *quercicola*); margins of dark areas of membrane sometimes separating into small specks, but general effect more mottled than spotted; median lobe of male genital structure with a flagellum bearing distinct teeth, figs. 176, 178 2

2. Length of first antennal segment less than width of head 3

Length of first antennal segment greater than width of head 4

3. First segment of antennae red with yellow spots...... **Group IV,** p. 201

First segment of antennae not red with yellow spots, but yellow, yellow with dark spots or brown to almost black............ **Group III,** p. 199

4. Antennae more black or fuscous than pallid; if second segment has a broad, pale area at middle, then dorsum chiefly dark brown to black; general coloration dark brown or black on a less dark background.............. .... **Group II,** p. 191

Antennae more nearly pale, yellowish or reddish rather than dark brown or black; second segment sometimes partly brown, but with larger pallid than brown areas; general coloration usually yellowish to reddish on a paler background... **Group IV,** p. 201

Group I

KEY TO SPECIES

1. First antennal segment greatly thickened; thickness nearly equal to dorsal width of an eye, fig. 173........ 2

First antennal segment more slender; thickness distinctly less than dorsal width of an eye, fig. 174.......... 3

2. Basal three-fou ths of second antennal segment yellowish, apical one-fourth black or very dark brown......... .... **lasiomerus,** p. 185

Second antennal segment uniformly yellowish, or very slightly dusky only at apex... **pallidicornis,** p. 185

3. Second antennal segment dusky yellow to pale brown, white at base; clavus pallid; corium with an oblique, dark brown band on basal half that joins a brown area extending along claval suture; length 3.80–4.00..... **breviusculus,** p. 190

Second antennal segment chiefly black, usually with white bands... 4

4. Second antennal segment black at base, with a light-colored band more distad; length of first antennal segment greater than width of pronotum at base; four small, black, conical projections, two on either side of median line, present near posterior margin of pronotum..... .... **antennalis,** p. 185

Second antennal segment with a light-colored band at base, black beyond 5

5. Third antennal segment with pale band at base and at middle....... 6

Third antennal segment with pale band at base only, or annuli entirely wanting.................. 7

6. Dorsum bearing both black and white scalelike hairs, which are turned on edge; ventral half of propleura pallid, but no distinct white line present above middle of coxal cleft. . . . . **conspurcatus,** p. 188
   Dorsum without distinct scalelike hairs; propleura white with dorsal margin black and a clear-cut, black line extending across ventral half of coxal cleft to basal margin. . . . . **davisi,** p. 187
7. Second antennal segment with a broad, pale yellowish to dusky area at middle, dark fuscous only at apex and next to pale band at base; small, slender species, length 5.10. . . . . **minutulus,** p. 188
   Second antennal segment black with a pale band at base, but, at most, only a narrow, pallid band at middle. 8
8. Corium with a longitudinal black vitta on middle of apical half, set on a grayish background, radius indicated by an interrupted series of black dots; length of first antennal segment equal to distance between tylus and basal margin of pronotum; second antennal segment with a light-colored area at base which is interrupted on ventral side by a black line. . . . . **vittatus,** p. 190
   Corium without a distinct longitudinal black vitta on a grayish background. 9
9. Hind femora very dark brown, apical half with small, pale dots only. . . . . **fumatus,** p. 188
   Hind femora black, with a large light-colored band or numerous large, pale spots. 10
10. Lower half of head black, or pallid and marked with black. 11
    Lower half of head white; tylus blackish only at base. 12
11. Second antennal segment with light-colored band at middle; mesopleura uniformly black. . . . . **corticevivens,** p. 186
    Second antennal segment without light-colored band at middle; mesopleura with pallid ray appearing as an extension of that on propleura . . . . **purvus,** p. 187
12. Length of first antennal segment equal to or greater than width of pronotum at base. . **albifacies** p. 186
    Length of first antennal segment not equal to width of pronotum at base 13
13. Femora black; hind pair with an oblique, subapical white band, usually a few small pallid dots nearby; length 6.50. . . . **tuberculatus,** p. 187
    Femora more pallid than black, apical half darkened with fuscous and broken by numerous large and small pallid spots; length 6.00. . . . . **sulcatus** p. 190

Phytocoris lasiomerus Reuter

Phytocoris lasiomerus Reuter (1909, p. 34). Known from Colorado, Iowa, Maine, Massachusetts, Minnesota, Montana, New York, Ontario, Quebec, Washington, Wisconsin, Wyoming. Not as yet recorded from Illinois, but should be found in the northern part.

Phytocoris pallidicornis Reuter

Phytocoris pallidicornis Reuter (1876, p. 69). Known from British Columbia, Colorado, Maine, Massachusetts, Michigan, Minnesota, Montana, New Hampshire, New York, North Dakota, Wisconsin. Not yet taken in Illinois, but should be found in the northern part.

Phytocoris antennalis Reuter

Phytocoris antennalis Reuter (1909, p. 32).

MALE.—Length 5.10, width 1.60. Head width 0.90, vertex 0.42; testaceous to very dark brown; tylus white with middle third black. Antennae, first segment, length 1.28, very dark brown, inner surface marked with four or five pale spots; second, 2.56, black, with a narrow, light-colored annulus slightly distad of base and a second, broader light band slightly beyond middle; third, 1.66, fusco-brownish, pale at base; fourth, 1.44, fuscous. Pronotum, length 0.79, width at base 1.43, testaceous to brownish and becoming black on area bordering sinuate pale area at posterior margin; two small, conical projections on either side of middle near posterior margin; propleura black, a pale ray extending across top of coxal cleft. Scutellum testaceous to fuscous, with a slender, nearly obsolete, pale median line. Hemelytra testaceous to fuscous and clothed with

yellowish, black and white pubescence; embolium with an elevated black spot at apex, also with a black area at middle which is broken by pale marks; corium with a darker area bordering clavus and a dark spot at middle on outer margin; cuneus reddish to black along outer margin and at apex, with a black tuft of hairs at middle of inner margin and a second one near inner basal angle. Membrane rather densely marbled with fuscous; more uniformly fuscous apically and at base and with a somewhat light-colored area near apex of cuneus, this spot invaded by fuscous marks; veins fuscous. Coxae white, with small lateral areas at base dusky red. Femora black, less dark at base; hind pair with light spots on ventral aspect and a rather distinct, subapical, light band on dorsal aspect; front pair mostly pale, with a longitudinal black bar on apical half of anterior face. Front tibiae reddish to black, with a pale annulus at middle of apical half, a narrower one near middle of basal half and a third, nearly obsolete one, near base; intermediate tibiae chiefly light, but marked with dark reddish; hind pair light colored, with variable dark brown marks; tarsi fuscous. Venter black, sides irregularly tinged with reddish; genital segment bearing, above base of left clasper, a broad, erect tubercle with a vague apical notch and another smaller tubercle above base of right clasper; claspers distinctive for species.

FEMALE.—Length 6.20, width 1.90; more robust than male, but very similar in coloration.

HABITS. — Usually collected at lights; probably predacious.

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Indiana, Massachusetts, Mississippi, New York, Oklahoma, Virginia.

Illinois Record. — CHAMPAIGN: June 13, 1888, C. A. Hart, 1 ♂.

Phytocoris albifacies Knight

Phytocoris albifacies Knight (1926g, p. 159).

FEMALE.—Length 5.90, width 2.30. Head width 1.11, vertex 0.46. Lower half of face, or ventrad to a line running through base of tylus and lower margin of eyes, white; vertex more or less colorless, a curved, white mark touching inner margin of each eye. Rostrum, length 3.43, attaining base of ovipositor, white, with third and fourth segments black. Antennae, first segment, length 1.80, black, dorsal aspect with two smooth, white spots on apical half and four or five smaller spots on basal half, spines both fuscous and light colored, short, length scarcely equal to thickness of segment; second, 3.30, mostly black, almost colorless at base for a space of 0.23, and a pale annulus of equal length beginning at middle; third, 1.77, black, paler at base; fourth, 1.31, black. Pronotum, length 1.06, width at base 1.69; black, with lower margin of propleura, xyphus, and collar to a point behind lower margin of eye, white; disk more or less fuscous, basal margin somewhat pale, with two black, elevated spots on either side of median line. Scutellum fuscous to black; basal angles and apex pale. Hemelytra black; with several small spots on embolium, base of cuneus, a triangular spot at apex of corium and spot near middle, tending toward pale. Membrane mostly very dark brown with paler areas sprinkled with fuscous dots; cubitus almost entirely colorless. Sternum and pleura black, margins bordering coxae pale. Venter principally black, with most of ventral area light except on last segment. Legs black with almost colorless marks much as in *corticevivens* Knight; femora black, with numerous minute, pale spots, a somewhat larger, light-colored spot indicating an oblique, subapical annulus. Dorsum clothed with rather short, black, simple pubescence intermixed with silvery and golden, silky pubescence.

MALE.—Length 6.00, width 2.00. Very similar to female in coloration, although generally darker. Genital claspers distinctive and indicating a close relationship to *corticevivens*.

HABITS.—Occurs on the bark of pecan trees where it is probably predacious.

KNOWN DISTRIBUTION. — Illinois and Mississippi.

Illinois Record. — HARRISBURG: June 15, 1934, at lights, DeLong & Ross, 1 ♀.

Phytocoris corticevivens Knight

Phytocoris corticevivens Knight (1920, p. 63, pl. 1, fig. 6).

MALE.—Length 6.60, width 2.30. Head width 1.04, vertex 0.39. Rostrum, length 3.03, reaching fifth abdominal sternite. Antennae, first segment, length 1.60, black, basal half with five or six small, smooth, white spots, each bearing a few erect, short

bristles; second, 3.00, very dark brown, with a pallid band at base and another, narrow one at middle; third, 1.69, black, pallid only at base; fourth, 1.30, black. Pronotum, length 1.16, width at base 1.90. Dorsum clothed with rather short, recumbent, black pubescence intermixed with yellowish to golden, silky hairs. General coloration black, with small, light-colored spots on embolium, between calli, on apical area of corium, and a narrow, pale area at base of cuneus. Membrane almost colorless, thickly and rather uniformly marbled with fusco-brownish. Legs black; hind femora with a few small, light spots; entire coxae light colored, except at bases; tibiae with two pallid bands, those of hind pair becoming obsolete, spots and spines of tibiae almost white. Genital claspers distinctive, fig. 175, a small tubercle present above base of each clasper.

FEMALE.—Length 6.80, width 2.50. More robust than male, but very similar in color and pubescence.

HABITS.—Predacious. In Minnesota, I collected a series of nymphs and adults on the bark of sugar maple (*Acer saccharum*); both nymphs and adults were well concealed as they crouched in crevices of the bark, apparently awaiting their prey.

KNOWN DISTRIBUTION.—Connecticut, Illinois, Iowa, Maryland, Minnesota, Missouri, New Jersey, New York, Ohio, Ontario, Texas, Wisconsin.

Illinois Records.—NORTHERN ILLINOIS: 7 ♀; July, 1 ♀. ALGONQUIN: 1 ♂; June 5, 1895, 1 ♂. FOX LAKE: June 10, 1936, Ross & Burks, 2 ♀. GALESBURG: June 21, 1892, 1 ♂. URBANA: May 31, 1889, C. A. Hart, 1 ♀.

Phytocoris tuberculatus Knight

Phytocoris tuberculatus Knight (1920, p. 64.)

MALE.—Length 6.50, width 2.10. Head width 1.10, vertex 0.39; lower half of head white; very dark brown across base of tylus; frons with oblique dark lines. Rostrum, length 3.42, extending to sixth abdominal sternite. Antennae, first segment, length 1.51, black, dorsal aspect with several smooth, white spots; second, 3.12, black, pallid at base, a yellowish annulus at middle, this band sometimes nearly obsolete; third, 1.86, black, pallid at base. Pronotum, length 1.16, width at base 1.95. Dorsum clothed with short, black pubescence intermixed with pale yellowish, silky hairs. General color fuscous to black; pronotum and scutellum with paler areas; embolium with small pallid spots. Membrane fuscous, paler areas stippled with small fuscous dots. Legs black, coxae light colored, hind femora with an oblique white band near apex and a few small, pallid spots an apical half. Genital claspers, flagellum, long tubercle above base of left clasper, and shorter one above right clasper, distinctive for species, fig. 175.

FEMALE.—Length 6.90, width 2.55. More robust than male; very similar in coloration, but dorsum often lighter in color.

HABITS.—Collected chiefly at lights.

KNOWN DISTRIBUTION. — Illinois, Indiana, Michigan, Missouri, New York, North Carolina, Oklahoma, Texas, Wisconsin.

Illinois Records. — GALESBURG: 1 ♂. URBANA: June 20, 1909, 1 ♂.

Phytocoris davisi Knight

Phytocoris davisi Knight (1923*d*, p. 624).

Not taken in Illinois; known only from New Jersey and New York.

Phytocoris purvus Knight

Phytocoris purvus Knight (1927*b*, p. 17).

This species is allied to *minutulus* Reuter, but differs from it in the shorter first antennal segment, the black second antennal segment with a narrow, pale annulus at base only, in the larger eyes and narrow vertex, the distinctive subapical marks on the scutellum, and the structure of the male genital claspers.

MALE.—Length 5.50, width 1.90. Head width 1.05, vertex 0.22; eyes large and prominent, vertex chiefly almost colorless, frons with six transverse dark lines, ventral area of frons and tylus black, a V-shaped white mark on basal half of tylus, juga white with a transverse black mark on dorsal half, lora black with a light-colored area on lower margin which joins the similarly colored areas on the much reduced genae and gula. Rostrum, length 2.60, extending to fifth abdominal sternite, pale yellowish with apex very dark brown. Antennae, first segment, length 1.11, only slightly greater than width of head, black, with ventral side light, black area broken by several white spots, a white seta arising from each spot; second, 2.80, black, narrow pale area at base; third, 1.45,

black, narrow pale area at base; fourth, 1.09, black. Pronotum, length 0.83, width at base 1.51; fuscous to black, paler on calli and central area of disk, lower margin of propleura almost white. Scutellum pale, with a pair of well defined dark brown, subapical, marginal spots. Sternum pale, sides and pleura black. Dorsum rather uniformly dark fuscous, with light-colored spots on embolium and a somewhat paler area at middle of corium. Clothed with fuscous, simple pubescence, intermixed with white, silky hairs in numerous spots. Membrane almost colorless, speckled with numerous small brownish to fuscous spots, the preapical area and margins of areoles more evenly fuscous; veins fuscous, white areas present around apices of areoles. Legs black, marked with more or less confluent, white spots, these spots forming a well-defined preapical white annulus. Genital claspers distinctive; left clasper with inner arm much flattened, right clasper shaped much as in *quercicola* Knight.

FEMALE.—Length 5.30, width 2.00. Very similar to male in pubescence and coloration.

HABITS.—Collected chiefly about lights; a single Illinois specimen was taken on cypress (*Taxodium distichum*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Iowa, Maryland, South Carolina.

Illinois Record. — KARNAK: July 28, 1930, on *Taxodium distichum,* Knight & Ross, 1 ♀.

Phytocoris minutulus Reuter

Phytocoris minutulus Reuter (1909, p. 24).

Not taken in Illinois; known from Maryland, Massachusetts, New Hampshire, New York, North Carolina, Pennsylvania, Virginia.

Phytocoris fumatus Reuter

Phytocoris fumatus Reuter (1909, p. 25).

MALE.—Length 7.00, width 2.30. Head width 1.17, vertex 0.40; front with five oblique black lines on either side of median line and a transverse black area between bases of antennae; lower half of face white; base of tylus, base of jugum, and spot on dorsal margin at base of lorum, black; a rather irregular reddish band extends across middle of tylus. Rostrum, length 4.20, attaining base of genital segment, pale with apical segment brownish. Antennae, first segment, length 1.57, equal to distance between posterior margin of pronotum and a line drawn through eyes at a point slightly before middle, black, with pale spots on dorsal side, two largest spots on apical half; second, 3.10, dark brown with pallid areas on dorsal side at base and middle, areas at middle vague; third, 1.79, black with almost white area 0.17 wide at base; fourth, 1.30, black. Hemelytra fuscous to black; a large yellowish and translucent spot at apex of corium near base of cuneus; embolium irregularly translucent and darkened with fuscous; cuneus very slightly lighter at base, a tuft of black hair on inner margin near base and a similar tuft at apex of corium; pubescence black, intermixed with pale, silky pubescence. Membrane pale, thickly and rather uniformly marbled with fusco-brownish; veins dark, pale at apex of larger areole. Legs very dark brown, entire coxae light colored except spot near base; trochanters pallid; femora with numerous, small, pallid spots, a slightly larger, nearly colorless spot on anterior aspect near apex, this mark not quite forming a subapical band; front and middle tibiae pale at middle and with another, rather distinct pale band at middle of apical half; tarsi fuscous. Venter black, with yellowish pubescence; genital segment and claspers distinctive, fig. 175.

FEMALE.—Length 7.60, width 2.60; larger and more robust than male; very similar to male in coloration, but dorsum lighter colored; first antennal segment longer than in male, equal to distance between posterior margin of pronotum and a line drawn through front margins of eyes.

KNOWN DISTRIBUTION.—District of Columbia, Georgia, Illinois, Massachusetts, New Jersey, New York, North Carolina.

Illinois Record.—CHAMPAIGN: July 7, 1887, C. A. Hart, 1 ♂.

Phytocoris conspurcatus Knight

Phytocoris conspurcatus Knight (1920, p. 61).

This species is distinquished by its dark, marbled membrane and by the pale band at the middle of the first and second antennal segments; the dorsum is thickly clothed with black, deciduous, scalelike hairs intermixed with small patches of dense, white, woolly hairs.

MALE.—Length 5.90, width 2.10. Head width 1.06, vertex 0.34; infuscation similar

to that of *canadensis* Van Duzee. Rostrum, length 2.60, attaining base of genital segment. Antennae, first segment, length 1.20, black, with irregular minute, white spots beset with from 14 to 16 almost colorless setae; second, 2.50, black, with a light-colored annulus at base and a second, similar band beginning at middle and extending dark fuscous to black, more or less pallid on under side at base; genital claspers and long tubercle above base of left clasper, fig. 175, distinctive for species.

FEMALE.—Very similar to male in size and coloration.

HABITS.—This is a predacious, bark-inhabiting species, which the author has taken

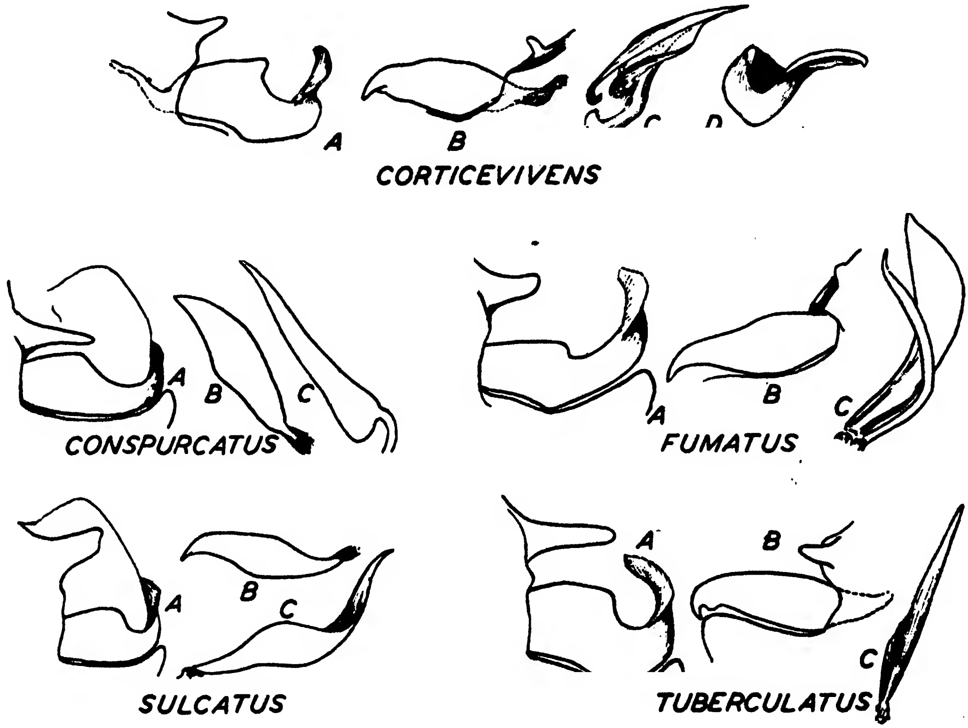


Fig. 175.—Male genital claspers of *Phytocoris*, Group I. *A*, left clasper, lateral aspect; *B*, right clasper, lateral aspect; *C*, flagellum; *D*, left clasper, caudal aspect.

for a space of 0.30; third, 1.48, pallid at base and at middle; fourth, 1.11, black. Pronotum, length 1.54, width at base 1.70; form and coloration very similar to those in *eximius* Reuter, but differing by having black, scalelike hairs; scutellum thickly covered with white, woolly pubescence. Hemelytra rather uniformly darkened, a triangular pallid spot at tip of corium bordering cuneus; thickly clothed with black, scalelike hairs intermixed with small patches of dense, white, woolly hairs. Membrane thickly marbled with dark fuscous; cubital vein pallid at apex of larger areole; dark spots scattered near apices of cells. Legs marked very much like those of *canadensis*, but pale band near apex of hind femora more or less interrupted on ventral side. Venter on the boles of linden (*Tilia americana*), elm (*Ulmus* sp.), walnut (*Juglans nigra*), pear (*Pyrus communis*), apple (*Pyrus malus*), willow (*Salix* sp.) and maple (*Acer* sp.); frequently attracted to light.

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Iowa, Kansas, Maryland, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, Ontario, Pennsylvania, South Dakota, Wisconsin.

Illinois Records.—Twenty-three males and 23 females, taken May 17 to September, are from Alton, Antioch, Carbondale, Champaign, Darwin, Galesburg, Grafton, Havana, Mahomet, Odin, Palos Park, Quincy, Shawneetown, Starved Rock State Park, Urbana.

Phytocoris vittatus Reuter

Phytocoris vittatus Reuter (1909, p. 28).

Not taken in Illinois; known only from New York; has been collected on prickly gooseberry (*Ribes cynosbati*).

Phytocoris sulcatus Knight

Phytocoris sulcatus Knight (1920, p. 64).

In form, this species is very similar to *fumatus* Reuter, but the latter is larger; the pronotum of *sulcatus* is more distinctly sulcate at the sides and immediately behind the calli; the pallid bands at the base and the middle of the second antennal segment are more distinct; the dorsum is distinctly paler; and the outer half of the clavus and the inner apical angles of the corium are very dark brown, almost black.

MALE.—Length 6.00, width 1.80. Head width 1.08, vertex 0.30. Rostrum, length 2.80, extending to fifth abdominal sternite. Antennae, first segment, length 1.25, black, with one large and several small white, smooth spots; second, 2.64, mostly black, pallid at base and a yellowish band at middle; third, 1.47, fuscous, pallid at base; fourth, 1.21, dark fuscous. Pronotum, length 0.99, width at base 1.60; lateral margins of disk and immediately behind calli distinctly sulcate. Dorsum clothed with silvery to yellowish, silky pubescence, intermixed with more nearly erect, short, black hairs. General color fuscous to black, with paler spots and areas; membrane pallid, rather thickly and evenly marbled with fuscous. Femora with a broad pallid area at base, apical half black with several pallid spots; hind pair with an irregular, oblique, subapical pallid band. Front and middle tibiae with black and white bands; hind pair without distinct white bands. Genital claspers, flagellum and a large, thick tubercle above base of left clasper, fig. 175, distinctive for species.

FEMALE.—Length 6.00, width 2.03. More robust than the male but very similar in color and pubescence.

HABITS.—Occurs on the bark of linden (*Tilia americana*), on bur oak (*Quercus macrocarpa*) and elm (*Ulmus* sp.); probably predacious.

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Iowa, Kansas, Michigan, Minnesota, Pennsylvania, South Dakota, Virginia.

Illinois Records.—Five males and 7 females, taken May 22 to Aug. 21, are from Argo, Beverly Hills, Champaign, Dubois, Galesburg, Quincy, St. Anne, Urbana.

Phytocoris breviusculus Reuter

Phytocoris breviusculus Reuter (1876, p. 68).

MALE.—Length 3.90, width 1.60. Head width 0.84, vertex 0.30; lower face white, marked with reddish brown. Rostrum, length 1.94, extending to sixth abdominal sternite. Antennae, first segment, length 0.63, reddish brown, marked with four or five white, smooth spots, spines pallid; second, 1.51, dusky yellow, white annulus at base; third, 1.04, fuscous, pallid at base; fourth, 0.78, fuscous. Pronotum, length 0.78, width at base 1.38, disk dusky yellow, central area more nearly pure yellow, basal edge white, this white area bordered by an undulating, fuscous line. Dorsum clothed with simple fuscous hairs thickly intermixed with white and yellowish, silky pubescence. Hemelytra pale yellowish; broad fuscous area along claval suture; inner apical angles and a broad, transverse band on basal half of corium fuscous. Cuneus yellowish to white; disk with several small brown dots; apex fuscous. Membrane thickly marbled with fuscous; two small, white spots on outer margin of apical half. Legs pale yellowish; hind femora very dark brown, this dark color broken by numerous pale dots; front and middle femora marked with reddish brown on apical half. Tibiae with three fuscous bands; hind pair dark fuscous with numerous white dots. Genital claspers distinctive, a prominent tubercle above base of left clasper.

FEMALE.—Length 4.10, width 1.64. More robust than male, but very similar in color and pubescence.

HABITS.—A predacious species which may be collected about lights. Reared in Ohio on apple branches which were heavily infested with San José scale.

KNOWN DISTRIBUTION.—Alabama, District of Columbia, Illinois, Indiana, Mississippi, Ohio, Texas. Common in Texas, but rare east of the Mississippi River.

Illinois Records. — ALBION: July 16, 1937, on blackberry, Mohr & Burks, 3 ♂. ALTON: July 19-21, 1932, on *Crataegus*, Ross & Dozier, 3 ♂, 4 ♀. FAIRFIELD: June 12, 1934, DeLong & Ross, 1 ♀. JONESBORO: Aug. 2, 1932, H. L. Dozier, 1 ♀. URBANA:

July 31, 1932, H. L. Dozier, 1 ♂; Sept., 1932, T. H. Frison, 1 ♂, 2 ♀.

Group II

KEY TO SPECIES

1. Apex of abdomen with claspers (males); couplets 2–17 illustrated in fig. 176 2
   Apex of abdomen without claspers (females); fully mature, well preserved specimens necessary for this section of key 18
2. Basal shoulder of left clasper with thumblike projection, *e.g., erectus* .. 3
   Basal shoulder of left clasper without thumblike projection, *e.g., husseyi*. 5
3. Basal projection of left clasper extending vertically as a tall, thick process bluntly rounded at apex... .... **erectus,** p. 199
   Basal projection of left clasper rather slender and acute, *e.g., canadensis* .. 4
4. Right clasper with dorsal process extending half the length of ventral process .... **canadensis,** p. 193
   Right clasper with dorsal process not over one-third the length of ventral process ...... **brevifurcatus,** p. 194
5. Basal shoulder of right clasper without angulate projection, *e.g., schotti* 6
   Basal shoulder of right clasper with a thumblike or angulate projection, *e.g., penipecten* 9
6. Basal shoulder of right clasper with a rounded hump...... **schotti,** p. 197
   Basal shoulder of right clasper without rounded hump, *e.g., husseyi*... 7
7. Genital segment with a distinct tubercle above base of left clasper...... .... **husseyi,** p. 199
   Genital segment without tubercle above base of left clasper, *e.g., obtectus* 8
8. Base of left clasper with angulate shoulder.......... **obtectus,** p. 199
   Base of left clasper without angulate shoulder.......... **salicis,** p. 196
9. Tip of right clasper hooked downward .... **penipecten,** p. 199
   Tip of right clasper projecting straight or curved upward, *e.g., buenoi, spicatus* 10
10. Tip of right clasper straight, *e.g., buenoi* 11
    Tip of right clasper curved upward, *e.g., spicatus* 12
11. Base of left clasper convexly rounded .... **buenoi,** p. 197
    Base of left clasper sinuate.......... .... **nigricollis,** p. 197
12. Basal shoulder of right clasper with a slender fingerlike process projecting vertically, *e.g., spicatus*....... 13
    Basal shoulder of right clasper with a more angulate process, *e.g., lacunosus* 14
13. Basal fingerlike process of right clasper tapering very little on apical half.. .... **spicatus,** p. 196
    Basal fingerlike process tapering gradually from base to apex.......... .... **cortitectus,** p. 196
14. Thumblike process at middle of right clasper sloping away from tip of clasper.......... **lacunosus,** p. 197
    Thumblike process at middle of right clasper vertical in position, *e.g., onustus* 15
15. Wall of genital segment with a prominent, blunt tubercle at a point well above base of left clasper......... .... **arundinicola,** p. 198
    Wall of genital segment without tubercle above base of left clasper...16
16. Apical half of right clasper with sides parallel to point near apex... .... **angustulus,** p. 197
    Apical half of right clasper tapering gradually from base, *e.g., onustus*..17
17. Length of right clasper beyond base of dorsal process equal to four times the width of base at this point .... **onustus,** p. 194
    Length of right clasper beyond base of dorsal process not over two and one-half times the width of base at this point........ **neglectus,** p. 194
18. Corium with distinct black or dark fuscous mark across apical area, this mark extending obliquely from radius to inner apical angle of corium; dark area never broken with numerous, minute, light-colored spots 19
    Corium without distinct black mark across apical area; sometimes with a fuscous area, but this dark color broken by numerous, paler spots, or, if not, then dark-colored area on radius distinctly darker than oblique infuscation on corium.......... 28

19. Pronotal disk uniformly deep black, with a narrow, pale area at basal margin; scutellum yellowish, with an oblique, black mark on either side of median line beginning at middle of disk and extending to margin at a point slightly beyond middle..........**nigricollis**, p. 197
    Pronotal disk pale grayish to very deep gray, always paler on middle and never deep black............20

20. Scutellum with distinct black mark on either side of apical half extending from lateral margin obliquely cephalad to near middle of disk........21
    Scutellum with black spot at margin on either side of apical half, this mark scarcely longer than broad, at most not extending more than half way to middle of disk........24

21. Pale areas at lower margins of propleura extending upon sides of sternum; hind femora mostly black except at base; pale spots small, largest spot not wider than narrow pale band located slightly beyond middle of apical half.............................. **husseyi**, p. 199
    Pale areas at lower margins of propleura not extending upon sides of sternum......................22

22. Hind femora of female with large irregular pale spots on anterior face, these spots connected by a longitudinal, almost colorless bar which does not attain subapical pale band; length 7.30–7.60....**onustus**, p. 194
    Hind femora of female with small spots; without distinct, longitudinal pale bar on anterior face..........23

23. Membrane with infuscation on central area tending to separate into small specks; front of head with black, transverse striations on either side of median line.............................. **neglectus**, p. 194
    Membrane more uniformly infuscated, color not separating into small specks; front of head without distinct, black striations even when hemelytra are very dark; reddish lines usually evident on frons.......................**spicatus**, p. 196

24. Hind femora with distinct white band placed slightly beyond middle of apical half, and usually with large, light-colored spots near middle....25
    Hind femora without distinct white band on apical half; light-colored spots usually rather small........27

25. Second antennal segment black except at base, dorsal aspect not distinctly paler; scutellum and clavus clothed with erect black hairs intermixed with prominent white, silky pubescence...............**buenoi**, p. 197
    Second antennal segment distinctly almost white or yellowish on dorsal aspect, darker at apex and on area bordering light-colored basal annulus...........................26

26. Propleura mostly black, only lower margin white; tibiae with distinct light-colored and black bands..... ....**canadensis**, p. 193
    Propleura mostly pale, with a longitudinal, black ray crossing coxal cleft; tibiae light to dusky, not banded.......**arundinicola**, p. 198

27. Corium with very heavy, triangular black mark set obliquely across apex; hind femora with two or three large white spots on dorsal surface; cuneus usually reddish..**erectus**, p. 199
    Corium with light, almost interrupted fuscous mark set obliquely across apex; hind femora with small white spots only; cuneus rarely if ever reddish.........**brevifurcatus**, p. 194

28. Apical half of corium distinctly greenish; second antennal segment black with pale annulus at base........ ....**penipecten**, p. 199
    No part of corium distinctly green...29

29. Hemelytra more brownish than black; dark color on apical area of corium and on middle of clavus broken into small spots.....................30
    Hemelytra sometimes brownish, but usually black; dark area not distinctly broken into small spots....31

30. Second antennal segment uniformly black except for pallid annulus at base; vertex narrow, its width less than dorsal width of an eye....... ....**schotti**, p. 197
    Second antennal segment chiefly yellowish brown, black at apex and on area bordering pallid basal annulus; vertex wider, equal to dorsal width of an eye...........**salicis**, p. 196

31. Front and vertex almost colorless to yellowish, not distinctly marked with black, rarely with short, vague, red lines near each eye; scutellum almost colorless to yellowish; a small rounded, brown to fuscous spot located near either margin at middle of apical half...**angustulus**, p. 197
    Front and vertex marked with transverse black lines.................32

32. Scutellum chiefly very dark brown, with irregular paler spots; a median, slender, pale line present, this line irregularly invaded by the darker color.............**obtectus**, p. 199
    Scutellum chiefly pale to grayish, but with black mark at either side on apical half......................33

33. Corium with a longitudinal pale area that extends upon base of cuneus without interruption; a black line paralleling radius but, at apex, curving outward to fracture...... ....**lacunosus**, p. 197
    Apical half of corium rather distinctly darkened with fuscous, scarcely paler than dark marks along radius ....**cortitectus**, p. 196

Phytocoris canadensis Van Duzee

Phytocoris eximius Knight (1920, p. 51) *not* Reuter.
Phytocoris canadensis Van Duzee (1920, p. 346).

MALE.—Length 5.70, width 2.00. Head width 0.94, vertex 0.35; yellowish, frequently tinged with reddish and marked with black. Rostrum, length 2.40, attaining basal margin of genital segment. Antennae, first segment, length 1.28, yellowish, with irregular fuscous mottling, bearing five or six long, almost colorless setae; second, 2.77, chiefly fuscous, paler at base for a space of 0.17, infuscation distinctly paler on dorsal aspect of middle third, but becoming darker toward either end; third, 1.60, chiefly dark fuscous, pale at base for a space of 0.14, with another very narrow, light-colored space at apex; fourth, 1.25, black. Pronotum, length 0.91, width at base 1.60, disk light yellow brown to fuscous, central area frequently grayish green, paler anteriorly, narrow light-colored area at basal margin, and six black points which frequently fuse located near basal margin; disk distinctly hairy, longest hairs at anterior angles, hairs taking color of surface from which they arise; propleura black, with lower margins and a mark extending across base of coxal cleft almost white. Scutellum dull yellow brown, with a black mark present on either side near apex. Hemelytra clothed with prominent yellowish pubescence intermixed with groups of white, deciduous woolly hairs, but dark hairs arising from dark areas; greenish gray to fuscous; base, middle and a triangular spot just before cuneus of corium, and several spots on embolium, paler and more or less translucent. Tip of embolium, an oblique, nearly triangular patch lying just inside of radius at apex of corium, and area bordering apical two-thirds of claval suture, fuscous to black. Cuneus translucent gray, with apex, a small point along inner margin, and a second near basal angle, black; paler parts usually showing some brownish or reddish coloration. Membrane fuscous, with a large, almost colorless area just beyond small areole and tip of cuneus, this area divided by a small fuscous spot which touches the margin; central area more or less invaded by a paler streak; cubitus distinctly pallid at apex of areoles. Legs, coxae and bases of femora pallid; front and intermediate femora with a series of irregular reddish brown to fuscous marks; posterior femora chiefly black with many large and small, light-colored spots; pale patches most numerous and tending to coalesce on inner side; an irregular, light-colored annulation located a short space before apex and a second one situated nearer middle, but latter annulus interrupted on outside. Tibiae with fuscous and pale annuli; hind pair infuscated and with irregular pallid spots; a broad, pale area on basal one-third; spines almost colorless to brownish. Genital claspers and flagellum, fig. 176, distinctive for species.

FEMALE.—Length 5.70, width 2.05. Usually very similar to male in coloration; imperfect or poorly colored specimens can never with certainty be distinguished from females of closely related species.

HABITS.—This species occurs on a number of plants in various situations; it is largely if not wholly, predacious. Collected in Illinois on hornbeam (*Carpinus caroliniana*), gooseberry (*Ribes* sp.) and buttonbush (*Cephalanthus occidentalis*).

KNOWN DISTRIBUTION.—Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas,

Maine, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Ohio, Ontario, Pennsylvania, South Dakota.

Illinois Records.—Eight males and 15 females, collected June 14 to Sept. 27, are from Antioch, Argo, Channel Lake, Danville, De Soto, Dolson, Galena, Harrisburg, Herod, Karnak, Lawrenceville, Marshall, Rock Island, Seymour, Shawneetown, Vienna. Blatchley (1926*b*, p. 720) records the species from Maywood under the name *eximius* Reuter.

Phytocoris brevifurcatus Knight

Phytocoris brevifurcatus Knight (1920, p. 53).

This species is very similar to *canadensis* Van Duzee, but lacks the heavy, oblique, fuscous mark at the apex of the corium; the second antennal segment is darker fuscous on the middle third; the head and pronotum are distinctly grayish green on the paler parts; the posterior femora have smaller pale spots and are not distinctly banded with pale yellow brown.

MALE.—Length 5.80, width 2.14. Head width 0.95, vertex 0.34. Rostrum, length 2.51, reaching to seventh abdominal sternite. Antennae, first segment, length 1.21; second, 2.55; third, 1.47; fourth, 1.34. Pronotum, length 0.91, width at base 1.69. Genital claspers distinctive for species, fig. 176.

FEMALE.—Length 5.80, width 2.20. Head width 0.96, vertex 0.41. Antennae, first segment, length 1.36; second, 2.77; third, 1.47; fourth, 1.21. Pronotum, length 0.91, width at base 1.70.

KNOWN DISTRIBUTION. — Illinois, New York, Ontario.

Illinois Record. — HORSESHOE LAKE: July 11, 1935, DeLong & Ross, 1 ♂.

Phytocoris neglectus Knight

Phytocoris neglectus Knight (1920, p. 54).

This resembles *canadensis* Van Duzee, but the second antennal segment is uniformly black with a white annulation at the base, the middle tibiae have an apical white band and the infuscation at the middle of the membrane tends to form small specks.

MALE.—Length 6.20, width 2.20. Head width 0.99, vertex 0.32. Rostrum, length 2.60, extending to fifth abdominal sternite. Antennae, first segment, length 1.17, black, with several white, smooth spots; second, 2.68, black, a narrow white annulus at base; third, 1.38, black, white at base; fourth, 1.05, black. Pronotum, length 0.91, width at base 1.75. Genital claspers and flagellum distinctive for species, fig. 176.

FEMALE.—Length 6.00, width 2.30. More robust than male, but very similar in color and pubescence.

HABITS.—I have collected this species most frequently on the bark of apple trees where both nymphs and adults fed on psocids. It has, also, been collected on the bark of other trees and is probably predacious on soft-bodied insects living in such situations. In New York the species was collected from June to October, which indicates two generations for the season.

KNOWN DISTRIBUTION. — Illinois, Iowa, Maine, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New York, Ontario, South Carolina, South Dakota, Washington.

Illinois Records. — ELIZABETHTOWN: May 27-31, 1932, H. L. Dozier, 1 ♂. FAIRFIELD: June 12, 1934, DeLong & Ross, 1 ♂. GALENA: June 28, 1935, DeLong & Ross, 1 ♂. KEITHSBURG: June 15, 1932, H. L. Dozier, 1 ♂. SHAWNEETOWN: June 23, 1936, DeLong & Ross, 1 ♀. URBANA: June 13, 1885, 1 ♂.

Phytocoris onustus Van Duzee

Phytocoris onustus Van Duzee (1920, p. 344).

MALE.—Length 6.80, width 2.50. Head width 1.08, vertex 0.35; head pale yellowish; oblique lines on frons, base and middle of tylus, lora, and base of jugum, fuscous to black. Rostrum, length 3.16, reaching fifth abdominal sternite. Antennae, first segment, length 1.41, black, with four or five white, smooth spots and a few yellowish bristles; second, 3.33, black, a narrow white annulus at base; third, 1.60, black, narrow white area at base; fourth, 1.29, black. Pronotum, length 1.12, width at base 2.00. Clothed with erect, short, black hairs intermixed with a moderate amount of recumbent, pale yellowish, silky pubescence. General color fuscous to black over a pale yellowish, ground color; propleura, except lower margin, black; lateral margins and basal band of pronotal disk, black; basal edge white; scutellum yellowish, a black marginal spot on either side on apical half; hemelytra

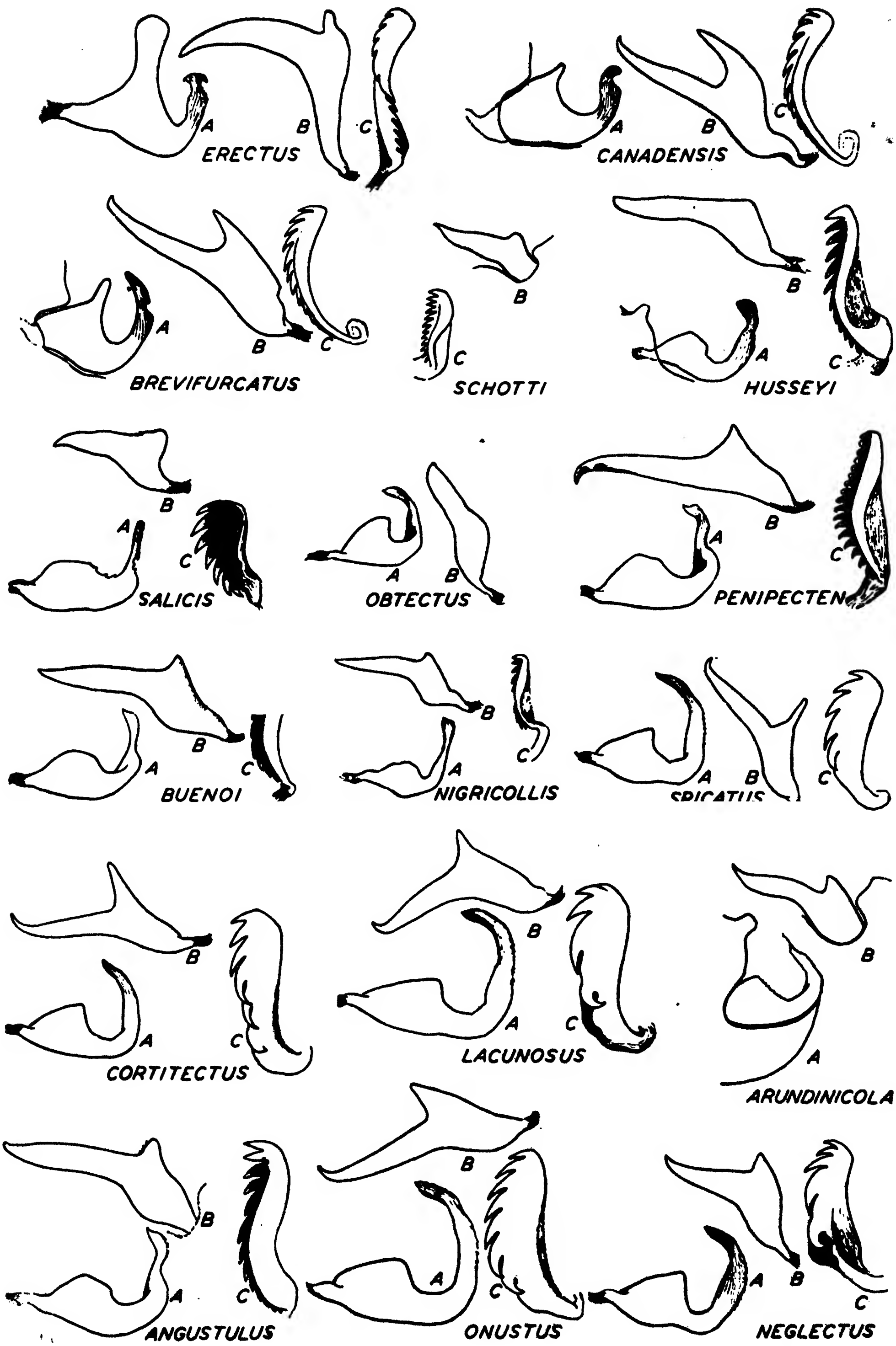


Fig. 176.—Male gential claspers of *Phytocoris*, Group II. *A*, left clasper, lateral aspect; *B*, right clasper, lateral aspect; *C*, flagellum.

shaded with very dark brown spots on embolium; an area at middle, and a triangular patch at outer apical angle of corium, pale yellowish and translucent; cuneus largely black with yellowish spots and a variable yellowish area at base. Membrane fuscous with a pale marginal spot on either side extending irregularly toward middle. Legs colored almost as in *canadensis* Van Duzee, but hind femora with large irregular pallid spots on anterior face, these spots connected by a longitudinal pale bar which does not attain subapical pale band. Genital claspers and flagellum distinctive for species, fig. 176.

FEMALE. — Length 7.10, width 2.64. Larger and more robust than male, but very similar in coloration.

HABITS.—I have collected this species most frequently on the bark of hickory trees (*Carya* sp.) in shaded, humid surroundings. The color of this mirid matches the bark so closely that it is difficult to see when it is crouching in crevices on the trunk of the tree. Predacious habits are indicated.

KNOWN DISTRIBUTION. — Georgia, Illinois, Maine, Massachusetts, New Hampshire, New York, Ontario, Pennsylvania.

Illinois Record.—NORTHERN ILLINOIS: July, 2 ♀.

Phytocoris cortitectus Knight

Phytocoris cortitectus Knight (1920, p. 55).

MALE.—Length 6.00, width 2.00. Head width 1.04, vertex 0.32. Rostrum, length 2.72, reaching to sixth abdominal sternite. Antennae, first segment, length 1.28, black, with eight or nine smooth, white spots; second, 2.94, fuscous to black, with a yellowish dorsal spot and a narrow white annulus at base; third, 1.64, black, yellowish at base; fourth, 1.21, black. Pronotum, length 0.86, width at base 1.60; calli whitish; disk dusky to fuscous; four black points located near posterior margin. Clothed with simple, black pubescence intermixed with tufts of silvery, silky hairs. Hemelytra translucent and slightly darkened, irregularly shaded with fuscous; without a strong, oblique, fuscous mark across apical area of corium; cuneus pale, translucent, with apical half infuscated; membrane fuscous, central area varied with lighter color. Legs pallid and darkened with fuscous; femora with numerous, small, almost colorless spots, hind pair with a well-defined, oblique, pallid band at middle of apical half; middle tibiae with an almost colorless band at apex.

FEMALE.—Length 6.20, width 2.16. Head width 1.01, vertex 0.39. Antennae, first segment, length 1.43; second, 3.11; third, 1.71; fourth, 1.43. Pronotum, length 0.95, width at base 1.65. More robust than male, but very similar in color and pubescence.

HABITS.—I collected specimens of this species only on the trunks of elm trees (*Ulmus* sp.) where the adults were well concealed as they crouched in crevices of the bark.

KNOWN DISTRIBUTION. — Illinois, New Hampshire, New York, Ontario.

Illinois Record.—ANTIOCH: July 5-7, 1932, T. H. Frison, 1 ♂.

Phytocoris spicatus Knight

Phytocoris spicatus Knight (1920, p. 55).

The coloration of this species is very similar to that of *neglectus* Knight, but the membrane is more uniformly infuscated.

MALE.—Length 6.00, width 2.00. Head width 1.04, vertex 0.29; frons with reddish lines. Rostrum, length 2.81, reaching sixth abdominal sternite. Antennae, first segment, length 1.38, black, with five or six white, smooth spots; second, 2.85, black, a narrow white annulus at base; third, 1.56, black, narrow white area at base; fourth, 1.12, black. Pronotum, length 0.91, width at base 1.73. Clothed with fuscous to black, simple pubescence intermixed with patches and tufts of silvery and some golden, silky pubescence. Genital claspers and flagellum distinctive for species, fig. 176.

FEMALE.—Length 6.30, width 2.20. More robust than male, but very similar in color and pubescence.

KNOWN DISTRIBUTION. — Illinois, Iowa, Maine, Maryland, Massachusetts, Minnesota, North Carolina, New York.

Illinois Record.—GALESBURG: 1 ♂.

Phytocoris salicis Knight

Phytocoris salicis Knight (1920, p. 56).

MALE.—Fig. 177. Length 6.00, width 2.12. Head width 0.97, vertex 0.35; head yellowish; oblique lines on frons and mark on middle of tylus reddish. Rostrum, length 2.73, reaching seventh abdominal sternite. Antennae, first segment, length 1.27, black, with three or four large, white, smooth spots; second, 2.85, dusky yellow to black,

basal annulus white; third, 1.55, black, pallid at base; fourth, 1.16. Pronotum, length 0.99, width at base 1.73. General coloration dusky to brownish; spots on base of pronotal disk, tip of clavus, apex of embolium and of cuneus, black; fuscous color-

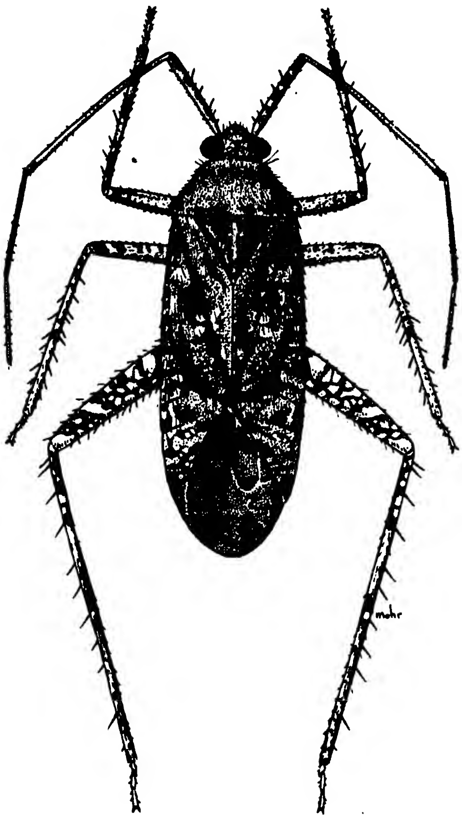


Fig. 177.—*Phytocoris salicis*, ♂.

ation of hemelytra interspersed with pallid and brownish marks and dots; membrane clear, marked with patches of fuscous; cubitus white around apex of larger areole. Legs pallid; apical half of femora marked with reddish brown; hind pair chiefly dark brown, with numerous white spots, a larger white spot forming an incomplete subapical band; tibiae banded with fuscous; apices of middle pair pallid; hind pair chiefly dark fuscous. Dorsum clothed with pale to brownish, simple pubescence thickly intermixed with silvery to golden yellow, silky hairs. Genital claspers and flagellum distinctive for species, fig. 176.

FEMALE.—Length 6.30, width 2.30. Antennae, first segment, length 1.34, chiefly white, irregularly marked with reddish brown; second, 2.98, yellowish brown, more fuscous at apex and next to pallid base; third, 1.47, black, pallid at base; fourth, 1.12, black. More robust than male and usually lighter in color.

HABITS.—Breeds on willow (chiefly *Salix nigra*) where the species appears to be predacious on soft-bodied insects.

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Dakota, Ohio, Ontario, Pennsylvania, South Dakota.

Illinois Records.—Seventeen males and 15 females, taken June 11 to July 9, are from Alton, Antioch, Elizabeth, Galena, Galesburg, Golconda, Monticello, Savanna, Seymour, Waukegan.

Phytocoris lacunosus Knight

Phytocoris lacunosus Knight (1920, p. 56).

Not taken in Illinois; known from Minnesota and New York. Collected on the bark of hornbeam (*Carpinus caroliniana*).

Phytocoris angustulus Reuter

Phytocoris angustulus Reuter (1909, p. 29).

Known from New York, North Carolina, Nova Scotia, Vermont; not yet collected in Illinois.

Phytocoris buenoi Knight

Phytocoris buenoi Knight (1920, p. 57).

Not taken in Illinois; known from Massachusetts, New York, Ontario. Adults and nymphs have been collected on Norway spruce (*Picea excelsa*).

Phytocoris nigricollis Knight

Phytocoris nigricollis Knight (1923*d*, p. 636).

Known only from New Hampshire and North Carolina.

Phytocoris schotti Knight

Phytocoris schotti Knight (1926*g*, p. 162).

The coloration of this species is suggestive of that of *salicis* Knight, but the dark areas are black rather than brown; the apical half of the corium is largely pallid, except near the inner margin, and is without an oblique infuscation; the cuneus is almost

entirely colorless, but the apex and two spots on the inner margin are black, while the outer margin is marked with red. The membrane is marbled with fuscous, and the areoles are chiefly dark fuscous, with white veins at apices. The legs are marked much as in *salicis,* but the black color on the femora is irregularly broken by two or three large, and many small, white spots.

MALE.—Length 5.20, width 1.90. Head width 1.00, vertex 0.26; frons with five or six oblique, reddish lines on either side of median line; base of tylus and spot on either side of basal half, dorsal margins of juga and lora, and slender median line on apical half of tylus, reddish. Rostrum, length 2.34, extending to fifth abdominal sternite. Antennae, first segment, length 0.97, very dark brown, with several small, smooth white spots on dorsal aspect, spines pale; second, 2.30, black, narrow pallid area at base; third, 1.23, black, pale at base and at extreme tip; fourth, 0.91, black. Pronotum, length 0.84, width at base 1.50; propleura black; lower margin, and spot at top of coxal cleft, white; the white of lower margin continued as a ray upon black sternum. Clothed with fuscous to black, simple pubescence intermixed with white, silky pubescence; more yellowish hairs on head and embolium than black ones. Genital claspers distinctive for species, fig. 176.

KNOWN DISTRIBUTION. — Illinois and New Jersey.

Illinois Record.—WHITE HEATH: Sept. 10, 1929, C. C. Goff, 1 ♂, KC.

Phytocoris arundinicola new species

This species is distinguished from allied ones by its general pale gray color, with a conspicuous black spot on the inner apical angle of the corium; it also is distinguished by the pale and black, unspotted, first antennal segment. The structure of the male genital claspers is distinctive, fig. 176; the genitalia are apparently nearest in form to those of *buenoi* Knight and *schotti* Knight.

MALE.—Length 5.60, width 2.16. Head width 0.95, vertex 0.35; head white to yellowish, with incomplete lines on frons; marks on middle and on median line at apex, basal half of lora, and dorsal half of bucculae, reddish brown to fuscous; a pair of marks, beginning on collum and extending across collar and between calli, distinctly red orange. Rostrum, length 2.64, extending to sixth abdominal sternite. Antennae, first segment, length 1.16, tapering to become more slender on apical half, chiefly white, black on anterior aspect, with only one or two small, pallid spots cutting into edge of dark color, setae short, brownish; second, 2.51, chiefly yellowish brown, black at apex and next to pallid basal annulus; third, 1.34, yellowish, fuscous apically; fourth, 0.73. Pronotum, length 0.88, width at base 1.60; pale yellowish to dusky; calli pallid; lower margin of propleura and area on coxal cleft whitish, a black ray crossing lower margin of coxal cleft and flaring out at basal margin; basal edge of disk white, bordered by four black points which are often connected by dark color. Dorsum clothed with pale to brownish, simple pubescence sparsely intermixed with more recumbent, silvery, silky pubescence. Scutellum usually pale yellowish, sometimes dusky; a small fuscous spot indicated on either margin at middle of apical half. Hemelytra dusky gray, with an irregular black area on middle of claval vein and a subtriangular one on inner apical angle of corium; embolium uniformly yellowish gray, except for darkened extreme tip; cuneus with apex and spot on inner margin, and spot on inner margin of paracuneus, fuscous to black. Membrane uniformly pale fuscous, scarcely paler near apex of cuneus; cubitus white around apex of areoles, fuscous where it separates areoles. Legs pale yellowish, tibiae without dark bands; spines yellowish to dark brown; hind pair with black microsetae; femora dark brown to black, with numerous, minute, pallid spots; hind pair with two rather distinct pallid bands on apical half; tarsi fuscous to black. Venter almost white to yellowish; lateral line fuscous; sides of genital segment fuscous. Genital claspers distinctive for species, fig. 176.

FEMALE.—Length 5.60, width 2.16. Head width 0.99, vertex 0.41. Antennae, first segment, length 1.21; second, 2.73; third, 1.55; fourth, 1.38. Pronotum, length 0.95, width at base 1.64. Very similar to male in color and pubescence, but light areas perhaps more extensive.

HABITS.—Breeds on switch cane (*Arundinaria tecta*); doubtless predacious.

Holotype, male.—Vienna, Ill.: July 10, 1935, DeLong & Ross.

Allotype, female.—Same data as for holotype.

Paratypes.—ILLINOIS.—VIENNA: Same

data as for holotype, 1 ♂, 3 ♀; June 14, 1934, DeLong & Ross, 3 ♂.

Phytocoris husseyi Knight

Phytocoris husseyi Knight (1923*d*, p. 639).

Not taken in Illinois; known only from Minnesota and Ohio.

Phytocoris erectus Van Duzee

Phytocoris erectus Van Duzee (1920, p. 345).

MALE.—Length 5.40, width 2.00. Head width 0.94, vertex 0.36. Rostrum, length 2.51, extending to fifth abdominal sternite. Antennae, first segment, length 1.16, black, basal two-thirds with white, smooth spots so large that black ground color is reduced to a network; second, 2.50, black, dorsal aspect partly yellowish brown, white annulus at base; third, 1.28, black, pallid at base and extreme tip; fourth, 1.20, black. Pronotum, length 0.87, width at base 1.56. Dorsum clothed with simple, fuscous pubescence intermixed with a moderate amount of silvery, silky pubescence. General color nearly white to yellowish, shaded with fuscous. Basal submargin of pronotal disk with the usual four black points; scutellum with oblique black marks on apical half; apical area of corium with heavy, very dark brown subtriangular mark, and a contrasting pallid spot just behind which joins with pallid basal half of cuneus; paracuneus reddish; membrane fuscous, with a paler spot near tip of cuneus and a smaller one just beyond on margin; cubitus white about tip of larger areole. Hind femora very dark brown, with numerous small and some large white spots and a rather distinct pallid annulus slightly beyond middle of apical half; tibiae banded with pallid and black, middle pair with pale band on apex. Genital claspers and flagellum distinctive for species, fig. 176.

FEMALE.—Length 5.30, width 2.10. More robust than male, but very similar in color and pubescence.

HABITS.—Predacious; Illinois specimens collected on willow (*Salix* sp.), cypress (*Taxodium distichum*) and hornbeam (*Carpinus caroliniana*).

KNOWN DISTRIBUTION.—Alabama, District of Columbia, Illinois, Iowa, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New York, Ohio, Ontario, Utah.

Illinois Records.—Twenty-seven males and 7 females, taken June 13 to Sept. 6, are from Algonquin, Antioch, Browns, Chicago, Duquoin, Eichorn, Galesburg, Harrisburg, Havana, Homer Park, Kankakee, Karnak, Mahomet, Maywood, Metropolis, Monticello, Pekin, Pulaski, Urbana, Vienna, White Heath.

Phytocoris penipecten Knight

Phytocoris penipecten Knight (1920, p. 58).

Not taken in Illinois; known only from Alabama, Connecticut, Louisiana, Massachusetts.

Phytocoris obtectus Knight

Phytocoris obtectus Knight (1920, p. 58).

Not taken in Illinois; known only from New York and Ohio.

Group III

The species of this group are apparently all phytophagous.

KEY TO SPECIES

1. Clavus and corium rather uniformly colored 2
   Clavus and corium not uniformly colored; marked with fuscous, or reddish brown to fuscous, with paler spots 4
2. Hemelytra reddish; embolium and cuneus translucent and yellowish .... **mundus**, p. 201
   Hemelytra yellowish to fulvous, or translucent and brownish 3
3. Hemelytra yellowish to fulvous; femora dusky yellow with numerous small, pale dots .... **fulvus**, p. 201
   Hemelytra dusky brown, translucent; femora reddish brown, with conspicuous white spots .... **uniformis**, p. 201
4. Hemelytra pale to yellowish; corium with an oblique, fuscous mark on basal half and a second one on inner apical angle; cuneus pale, apex and two spots on inner margin black .... **junipericola**, p. 201
   Hemelytra marked otherwise 5
5. Pronotal disk with black spots on basal margin; apical area of corium with strong fuscous marks .... **exemplus**, p. 201

Pronotal disk without black spots.... 6

6. Light-colored dots and spots on hind femora uniting to form a subapical band or transverse pale mark...... 7
   Dots on hind femora not forming a distinct light-colored band or large mark........................... 8

7. Cuneus with a narrow white area along outer margin and two black dots on this white edge. . **angustifrons**, p. 201
   Cuneus with outer margin reddish brown and marked with three or four white dots.......... **pinicola**, p. 201

8. Length of second antennal segment twice as great as width of head..... .... **diversus**, p. 200
   Length of second antennal segment less than twice width of head.......... .... **conspersipes**, p. 201

Phytocoris diversus Knight

Phytocoris diversus Knight (1920, p. 60).

The general aspect of this species is suggestive of *fulvus* Knight, but the light, yellow brown coloration on the inner apical half of the corium and the cuneus is more distinct.

MALE.—Length 5.00, width 1.70. Head width 0.97, vertex 0.37. Rostrum, length 2.03, reaching fifth abdominal sternite. Antennae, first segment, length 0.71, greenish yellow, darkened with deep brownish, with five or six smooth, white spots on dorsal side, and beset with 9 or 10 dark setae; second, 2.05, dark fuscous, paler on basal half; third, 1.05, black; fourth, 0.85, black. Pronotum, length 0.78, width at base 1.36. Clothed with brownish, simple hairs intermixed with silvery, silky pubescence. Head, pronotum and ventral parts greenish to yellowish; base of pronotum, sides of tylus, dorsal margins of juga and lora, base of head, indistinct striae on front, sternum, and sides of venter, tinged with reddish brown; femora, except at bases, and tibiae, deep brownish, with many light to white spots; hind femora with rather large spots on dorsal aspect. Genital claspers and flagellum distinctive for species, fig. 178.

FEMALE.—Length 4.80, width 1.73. Very similar to male in color and pubescence.

HOST PLANT. — White pine (*Pinus strobus*).

KNOWN DISTRIBUTION.—Illinois, Maine, Minnesota, New Hampshire, New York.

Illinois Records.—STARVED ROCK STATE

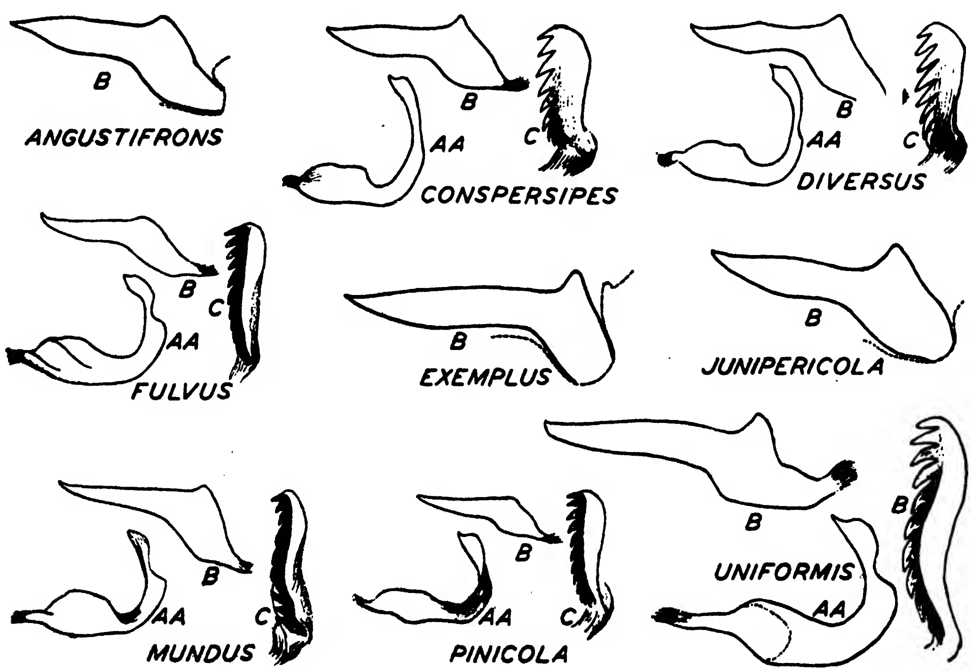


Fig. 178.—Male genital claspers of *Phytocoris*, Group III. *AA*, left clasper, dorsal aspect; *B*, right clasper, lateral aspect; *C*, flagellum.

PARK: July 14, 1932, on *Pinus strobus,* Dozier & Park, 11 ♂, 19 ♀; Sept. 17, 1935, DeLong & Ross, 1 ♂. WHITE PINES FOREST STATE PARK: July 12, 1934, DeLong & Ross, 2 ♂, 3 ♀.

Phytocoris mundus Reuter

Phytocoris mundus Reuter (1909, p. 18).

Not taken in Illinois; known from District of Columbia, Maryland, New Jersey, Pennsylvania, Virginia. Feeds on Virginia pine (*Pinus virginiana*).

Phytocoris fulvus Knight

Phytocoris fulvus Knight (1920, p. 59).

Not yet taken in Illinois; known from Maine, New York, Ontario, Pennsylvania. Occurs on white pine (*Pinus strobus*).

Phytocoris uniformis Knight

Phytocoris uniformis Knight (1923*d*, p. 643).

Originally described from Long Island, New York, and the coastal area of Massachusetts. This species has subsequently been recorded from Maryland, Mississippi, North Carolina, Virginia, but has not yet been taken in Illinois. It has been collected on pitch pine (*Pinus rigida*), which possibly is the normal host.

Phytocoris pinicola Knight

Phytocoris pinicola Knight (1920, p. 59).

Not taken in Illinois; specimens known from Connecticut, Massachusetts, Minnesota, Mississippi, New Jersey, New York. Feeds on pines (*Pinus resinosa* and *P. sylvestris*).

Phytocoris angustifrons Knight

Phytocoris angustifrons Knight (1926*g*, p. 164).

Not taken in Illinois; known only from Florida, Louisiana, Mississippi. Collected on pine (*Pinus* sp.).

Phytocoris exemplus Knight

Phytocoris exemplus Knight (1926*g*, p. 163).

Known at present only from Louisiana, but should be found wherever the cypress (*Taxodium distichum*) grows; that is the tree on which it occurs.

Phytocoris conspersipes Reuter

Phytocoris conspersipes Reuter (1909, p. 22).

Not taken in Illinois; known from District of Columbia, Maryland, New Jersey, North Carolina, Pennsylvania, South Carolina, Virginia. Feeds on Virginia pine (*Pinus virginiana*).

Phytocoris junipericola Knight

Phytocoris junipericola Knight (1927*b*, p. 16).

Known from District of Columbia, Indiana, Maryland; not yet taken in Illinois. Breeds on red cedar (*Juniperus virginiana*).

Group IV

The species of this group are phytophagous.

KEY TO SPECIES

1. Pronotal disk frequently red but without four distinct, reddish vittae on a paler background 2
   Pronotal disk with four orange or red vittae on a paler background 8
2. Pronotal disk with four black spots on basal submargin; scutellum usually uniformly pale, sometimes with indistinct fuscous dots forming a spot at either side of apical half........ ....**quercicola,** p. 202
   Pronotal disk without four distinct black spots on basal submargin; scutellum usually with orange or red at either side on apical half.... 3
3. Scutellum unmarked, uniformly yellowish.......................... 4
   Scutellum marked with reddish or fuscous.......................... 5
4. Hemelytra rather uniformly fusco-reddish to roseate; embolium and outer margin of scutellum paler.... ....**taxodii,** p. 203
   Hemelytra yellow; clavus and basal one-third of corium dark reddish; cuneus red with many minute, clear spots.............**luteolus,** p. 209
5. Pronotum chiefly red, more area red than pale or fuscous............ 6
   Pronotum with more area pale or fuscous than red................ 7
6. Hemelytra with many small, distinct, white spots; calli darkened with fuscous.... .....**confluens,** p. 205

Hemelytra with only indistinct, white spots, nearly uniformly deep orange red; calli pale....... **puella,** p. 207

7. Pronotal disk with base and lateral margins dark fusco-reddish; scutellum yellow, a red mark at either side on apical half but without vittae at middle of base.......... .... **infuscatus,** p. 204

Pronotal disk chiefly pale, not distinctly darkened laterally or at base; base of scutellum with an orange-colored vitta on either side of median line, these frequently extending to join with orange mark at either side on apical half........ **olseni,** p. 205

8. Second antennal segment almost colorless, with a slender, black line on anterior aspect; embolium and outer half of corium green; clavus greenish to fuscous, with a rather large, irregular, reddish blotch on middle and a smaller one on basal half................ **tibialis,** p. 205

Second antennal segment without a slender, black line on anterior aspect; embolium and outer half of corium marked with reddish...... 9

9. Hemelytra with a yellow, triangular area just before cuneus; clavus, basal area of corium and embolium, and cuneus, bright red but with many small, paler markings...... .... **venustus,** p. 206

Hemelytra and apical area of corium marked with reddish; or, if not, then basal half of corium not bright red. 10

10. First antennal segment reddish, with three or four large, smooth white spots and three or four small spots .... **rubellus,** p. 202

First antennal segment not distinctly marked with red and white spots. . 11

11. Apical area of corium, or area behind tip of clavus, without netlike marks; dorsum pale greenish yellow; markings of hemelytra dusky .... **caryae,** p. 207

Apical area of corium with netlike markings of orange or red........ 12

12. Length of first antennal segment greater than width of head and vertex combined....... **puella,** p. 207

Length of first antennal segment less than width of head and vertex combined............ **depictus,** p. 208

Phytocoris rubellus Knight

Phytocoris rubellus Knight (1926g, p. 166).

MALE.—Length 4.80, width 1.54. Head width 0.86, vertex 0.25. Rostrum, length 1.94, extending to base of fourth abdominal sternite. Antennae, first segment, length 0.81, reddish, with three or four large, smooth white spots and about the same number of small ones, set with six or eight pallid bristles, some of which in length exceed thickness of segment; second, 2.10, yellowish, sometimes tinged with red, apex dusky; third, 1.06, yellowish, apex dusky; fourth, 1.00, fuscous. Pronotum, length 0.71, width at base 1.28; reddish to fuscous; median line and line extending upon vertex, and frequently a line on either side of pronotal disk, pallid. Scutellum reddish, basal angles and apex yellowish. Hemelytra reddish to fuscous; embolium with several obsolete pallid marks. Cuneus reddish, and scarcely darker at apex. Membrane pale fuscous, marbled with paler color; veins fuscous although pale to reddish at apices of areoles. Legs pale yellowish to reddish and marked with paler spots, exhibiting more red than in *puella* Reuter. Clothed with pallid to fuscous, simple pubescence intermixed with white, silky pubescence, the latter tending to form spots on hemelytra.

FEMALE.—Length 4.80, width 1.63. Head width 0.86, vertex 0.37. Antennae, first segment, length 0.86; second, 2.06; third, 1.08; fourth, 0.95. Pronotum, length 0.77, width at base 1.37. Coloration usually a deeper red than in male; hemelytra pallid to red.

HOST PLANT.—Sandbar willow (*Salix longifolia*).

KNOWN DISTRIBUTION.—Illinois, Indiana, Iowa, Kansas, Missouri, South Dakota.

Illinois Records.—Twenty-six males and 30 females, taken June 1 to Aug. 24, are from Alton, Grafton, Grand Tower, Havana, Kankakee, Meredosia, Putnam, Quincy, Savanna, Starved Rock State Park, Waukegan.

Phytocoris quercicola Knight

Phytocoris quercicola Knight (1920, p. 60).

MALE.—Length 4.70, width 1.70. Head width 0.91, vertex 0.30. Basal half of lora, spot on either side of tylus, transverse mark across front, and four marks on vertex,

red; front with prominent, nearly colorless hairs. Rostrum, length 2.20, extending to base of genital segment. Antennae, first segment, length 0.97, pallid, three irregular marks on dorsal surface, broad, fusco-brownish or reddish band at apex, beset with six or eight prominent, pale spines; second, 2.25, pale brownish, pallid annulus at base, area next to this and at apex dark fuscous; third, 1.25, fusco-brownish, annulus at base and middle, and a narrow one at apex, pallid; fourth, 1.04, fuscous. Pronotum, length 0.75, width at base 1.43; yellowish, outer halves of calli, and broad area extending rearward, fusco-brownish to dark fuscous; a basal, submarginal, fuscous line with two black points on either side of median line; narrow area at basal margin pallid; pubescence yellowish to dusky, longest hairs situated anteriorly and on collar. Scutellum pallid, median line frequently reddish, either side of this an indistinct vitta composed of small brownish dots. Hemelytra pale yellowish, more or less translucent; an irregular patch at middle of clavus, and a larger one just opposite on corium, fusco-brownish, dark color broken by small, irregular, light spots; frequently apex of corium with a smaller, dark patch and a series of fusco-brownish spots bordering claval suture; embolium and cuneus with small spots of reddish in hypodermis. Membrane pallid; infuscation usually composed of fine irregular spots; a large spot at apex and a smaller one at either side joining margin, central area and that within areoles more sparsely marked with fuscous dots; cubitus pallid, radius infuscated. Front and middle tibiae pallid, with three fuscous annuli; hind pair with two reddish brown bands on basal half; femora pallid, reticulated with reddish brown; hind pair with two irregular pallid bands on apical half, dark color broken by numerous light-colored spots. Venter pallid, sides flecked with reddish. Genital claspers and flagellum distinctive for species, fig. 179.

FEMALE.—Length 4.80, width 1.80. Head width 0.95, vertex 0.36. Antennae, first segment, length 1.08; second, 2.25; third, 1.12; fourth, 1.04. Pronotum, length 0.82, width at base 1.56. Very similar to male in color and pubescence.

HOST PLANT.—Bur oak (*Quercus macrocarpa*).

KNOWN DISTRIBUTION. — Florida, Illinois, Iowa, Maryland, Massachusetts, Minnesota, New York, North Carolina, Ontario, Virginia.

Illinois Records. — CHAMPAIGN: June 27, 1932, on oak, Harper, 1 ♀. DUBOIS: Aug. 8, 1917, 1 ♂. GALESBURG: 1 ♂; June 24, 1892, 1 ♀; July 27, 1892, 2 ♂. GLENDON PARK: Aug. 19, 1903, A. B. Wolcott, 1 ♂, FM. URBANA: June 27, 1932, Frison & Ross, 2 ♂, 1 ♀; Aug. 11, 1932, on *Quercus macrocarpa*, H. H. Ross, 1 ♀; Sept. 12, 1891, C. A. Hart, 1 ♂.

Phytocoris taxodii Knight

Phytocoris taxodii Knight (1926g, p. 165).

This species is allied to *rufus* Van Duzee, a species known to occur only in Florida, but differs from it in the longer rostrum and longer first antennal segment; the basal half of the right genital clasper of the male is more slender in *taxodii* than in *rufus*.

MALE.—Length 5.10, width 1.70. Head width 0.94, vertex 0.26; color of head yellowish, sometimes tinged with red. Rostrum, length 2.50, attaining base of genital segment. Antennae, first segment, length 1.03, slightly thicker at base and apex, a few weak, yellowish setae on basal half, yellow to reddish; second, 2.34, yellowish; third, 1.30, yellowish to dusky; fourth, 1.05, dusky. Pronotum, length 0.80, width at base 1.40; reddish, becoming fusco-reddish near base of disk; narrow area at basal margin, median line on collar, and area between calli, paler. Scutellum yellowish or tinged with reddish. Clothed with golden yellow to brown, simple pubescence sparsely intermixed with more recumbent, silvery, silky pubescence. Hemelytra yellowish to reddish; inner apical angles of corium dark red to fuscous, but this dark color not extending forward along radial vein; cuneus rose red, narrow area along outer margin yellow; membrane fusco-brownish, veins red. Ventral surface and legs yellowish; hind femora reddish, except basal one-third, and with many small, yellowish spots; base of hind tibiae reddish. Genital claspers distinctive, fig. 179.

FEMALE.—Length 5.30, width 1.80. Head width 0.91, vertex 0.34. Antennae, first segment, length 1.10; second, 2.40; third, 1.31; fourth, 1.04. Pronotum, length 0.85, width at base 1.49. Very similar to male in color and pubescence.

HOST PLANT.—Bald cypress (*Taxodium distichum*).

KNOWN DISTRIBUTION. — Georgia, Illinois, Louisiana, Mississippi.

Illinois Records.—ELIZABETHTOWN: July 25, 1930, on *Taxodium distichum*, Knight & Ross, 3 ♀. HORSESHOE LAKE: July 11, 1935, DeLong & Ross, 1 ♀. PULASKI: June 28, 1909, 2 ♂.

Phytocoris infuscatus Reuter

Phytocoris infuscatus Reuter (1909, p. 20).

MALE.—Length 5.30, width 1.94. Head width 0.88, vertex 0.28; color of head yellowish, dorsal half of juga, basal half of lora, bucculae in part, and mark between bases of antennae, dark red; tylus dark red, two irregular, yellowish marks on basal half separated by small red wedge at base; front and vertex clothed with prominent yellowish hairs; either side of front with indications of transverse reddish lines. Rostrum, length 2.70, nearly attaining base of genital segment. Antennae, first segment, length 1.08, pale yellowish, fusco-brownish near apex, dusky at base, pubescence yellowish to dusky, basal half with five or six yellowish setae; second, 2.74, uniformly yellowish; third, 1.49, yellowish; fourth, 1.20, yellowish to fuscous. Pronotum, length 0.84, width at base 1.50; disk yellowish to fusco-reddish, basal submargin darker; calli and area between them pallid, collar yellowish, a reddish patch on either side of median line, also an orange spot just behind inner angle of each callus; clothed with rather prominent pallid to yellowish pubescence; propleura pallid, a fusco-brownish line crossing lower extremity of coxal cleft and extending to near posterior margin. Scutellum pale yellowish, a reddish spot on margin on either side of apical half, but broad, yellowish line at meson. Hemelytra with emboliar margins very slightly arcuate; reddish to fusco-reddish, with many more or less confluent,

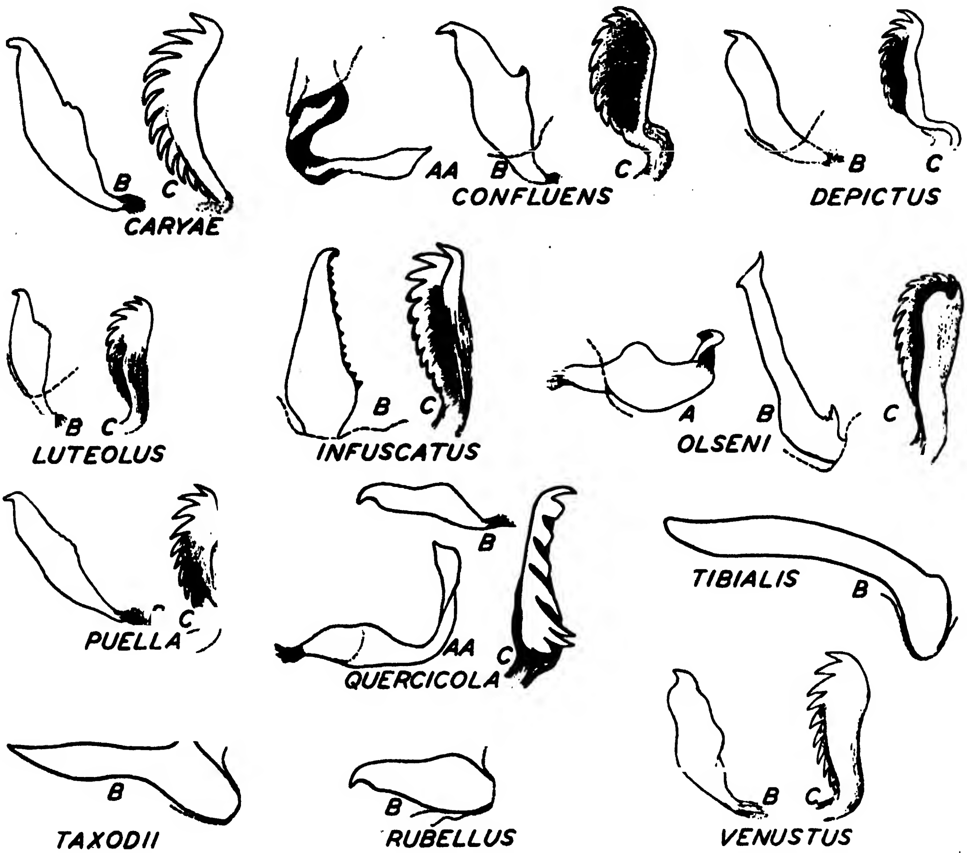


Fig. 179.—Male genital claspers of *Phytocoris*, Group IV. *A*, left clasper, lateral aspect; *AA*, left clasper, dorsal aspect; *B*, right clasper, lateral aspect; *C*, flagellum.

minute white spots, basal half more fuscous than reddish; cuneus red, broken by small, translucent spots at middle. Membrane smoky to fusco-brownish, infuscation of areoles somewhat broken into small spots, apical half with slightly darker fuscous area touching margin beyond cuneus. Legs pale yellowish; hind femora, except basal one-third, black with a red cast, with many, small yellowish spots and larger spots on dorsal aspect at middle, a yellowish band slightly beyond middle of apical half; front tibiae with indistinct brownish band on middle and near base; hind pair with broad, reddish band at base. Venter yellowish to fuscous, darker laterally and on genital segment. Genital claspers and flagellum distinctive for species, fig. 179.

FEMALE.—Length 5.50, width 2.00. Head width 0.91, vertex 0.39. Antennae, first segment, length 1.23; second, 2.94; third, 1.55; fourth, 1.17. Pronotum, length 0.86, width at base 1.51. More robust than male, very similar in coloration, but pale area on apical half of corium broader, and with pallid and orange rays behind calli.

HOST PLANT.—Hickory (*Carya* sp.)

KNOWN DISTRIBUTION.—District of Columbia, Georgia, Illinois, Iowa, Massachusetts, Mississippi, New York, North Carolina, Ohio, Pennsylvania.

Illinois Records. — ILLINOIS: June 26, 1892, 1 ♂. BLUFF SPRINGS: June 10, 1932, Ross & Mohr, 1 ♀. DUBOIS: July 3, 1909, 1 ♀. GEFF: June 12, 1934, DeLong & Ross, 1 ♀. QUINCY: June 15, 1883, 1 ♂.

Phytocoris olseni Knight

Phytocoris olseni Knight (1923*d*, p. 647).

Not taken in Illinois; known from Florida, Mississippi, New Jersey, New York, Virginia.

Phytocoris tibialis Reuter

Phytocoris tibialis Reuter (1876, p. 68).

MALE.—Length 5.10, width 1.90. Head width 0.88, vertex 0.35. Rostrum, length 2.60, extending to sixth abdominal sternite. Antennae, first segment, length 1.08, yellowish, with four or five reddish brown marks; second, 2.38, yellowish, a distinct fuscous to black line on anterior aspect, with white annulus at base; third, 1.47, fuscous, pale yellowish at base; fourth, 1.30, fuscous. Pronotum, length 0.86, width at base 1.47; greenish; disk with four longitudinal orange stripes. Hemelytra yellowish green to green; clavus with a rather large reddish blotch on middle and a smaller one on basal half; inner half of corium with reddish spots and blotches. Apex of cuneus and two spots on paracuneus reddish. Membrane fuscous, with irregular pale and translucent areas behind cuneus and extending across middle. Legs greenish yellow; front and middle tibiae with very dark red-brown line on dorsal aspect; hind femora with apical half dark red brown, this color area broken by numerous small and large, yellowish spots and a distinct subapical, pale yellowish annulus. Genital claspers distinctive, fig. 179; right clasper very long.

FEMALE.—Length 5.50, width 2.00. Head width 0.88, vertex 0.36. Antennae, first segment, length 1.12; second, 2.34; third, 1.51; fourth, 1.35. Pronotum, length 0.86, width at base 1.47. Clothed with yellowish to fuscous, simple pubescence sparsely intermixed with yellowish, silky pubescence. Coloration very similar to that of male.

HABITS.—Breeds among weedy, herbaceous plants in damp situations; Illinois specimens collected on mountain mint (*Pycnanthemum* sp.).

KNOWN DISTRIBUTION.—Alabama, Connecticut, District of Columbia, Florida, Illinois, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Ontario, Texas, Virginia, Wisconsin.

Illinois Records.—Forty-four males and 23 females, taken June 22 to Oct. 2, are from Albion, Alto Pass, Anna, Browns, Carbondale, Cave-in-Rock, Dongola, Dubois, East St. Louis, Elizabethtown, Gibsonia, Golconda, Grand Tower, Havana, Herod, Lawrenceville, McClure, Metropolis, Monticello, Newton, Norris City, Olive Branch, Pulaski, Rosiclare, Shawneetown, Temple Hill, York.

Phytocoris confluens Reuter

Phytocoris puella var. *confluens* Reuter (1909, p. 20).

MALE.—Length 4.60, width 1.43. Head width 0.83, vertex 0.26; head chiefly bright red; geminate mark at base of tylus, apices of juga and lora, and ventral margin of bucculae, pallid. Rostrum, length 2.20, reaching sixth abdominal sternite, pale yel-

lowish, black at apex. Antennae, first segment, length 1.00, reddish yellow, pubescence and spines pale yellowish; second, 2.42, uniformly yellowish; third, 0.91, yellowish; fourth, 1.57, yellowish. Pronotum, length 0.70, width at base 1.00; deep red, becoming almost black at anterior angles of disk; calli fuscous and red with almost colorless ray or spots behind each callus, basal margin with a slender, light colored area except at basal angles; propleura deep red, lower margins and xyphus pallid; clothed with yellowish to dusky pubescence; disk also with yellowish, silky pubescence. Scutellum red, basal angles and apex pallid; vague, light colored, median line present. Sternum and pleura dark red, ostiolar peritreme, and ventral margin of epimera, white. Hemelytra red, with many irregular, small to medium-sized spots; cuneus with pale spots on inner margin and across middle; hemelytra clothed with yellowish to dusky pubescence, intermixed with yellowish, silky pubescence which may be white over light spots. Membrane uniformly pale smoky, veins red. Legs pallid to yellowish; anterior femora reddish yellow at apices; tibiae with annulations; hind femora red, pallid at bases, with rather numerous, small, pallid spots although at times these spots nearly obsolete; hind tibiae with small red marks near bases; tips of tarsi fuscous. Venter white beneath, latero-dorsal margin deep red; each sternite with small spot of red laterally; eighth segment and base of genital segment dark fusco-reddish. Genital claspers and flagellum distinctive, fig. 179.

FEMALE.—Length 5.50, width 2.03. Head width 0.90, vertex 0.34. Antennae, first segment, length 1.25; second, 3.16; third, 1.51; fourth, 1.30. Pronotum, length 0.86, width at base 1.60. More robust than male, but very similar in color and pubescence.

HABITS.—Collected on oak (*Quercus* sp.) and red birch (*Betula nigra*).

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Kansas, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Ohio, Pennsylvania.

Illinois Records. — ASHLEY: Aug. 7, 1917, 2 ♀. DOLSON: June 25, 1932, Rocky Branch, Frison & Mohr, 1 ♂. DUBOIS: Aug. 8, 1917, 1 ♀. FAIRFIELD: June 12, 1934, DeLong & Ross, 1 ♂. GALENA: June 30, 1932, on *Quercus* sp., Dozier & Mohr, 1 ♂. GALESBURG: June 27, 1893, 1 ♂. HARRISBURG: June 25, 1932, on *Betula nigra*, Ross, Dozier & Park, 2 ♂. OAKWOOD: June 14, 1930, T. H. Frison, 1 ♀.

Phytocoris venustus Knight

Phytocoris venustus Knight (1923*d*, p. 651).

MALE.—Length 4.50, width 1.60. Head width 0.86, vertex 0.28; head orange colored above; spot on either side of vertex and one at base, two spots on median line of front, and base of tylus, light colored; lower half of head pallid; base of juga, dorsal margin of lora, and irregular band across middle of tylus, bright red. Rostrum, length 2.00, reaching sixth abdominal sternite, yellowish, black at apex. Antennae, first segment, length 0.97, pale yellowish, darker at apex, setae pale; second, 0.80, uniformly yellowish; third, 1.34, yellowish; fourth, 1.16, yellowish. Pronotum, length 0.68, width at base, 1.37; pale, with two orange stripes behind either callus, outer stripe continued around callus and extending to anterior angle and collar; small orange spot before callus; collar orange red; propleura with red ray crossing lower half of coxal cleft, but not extending to posterior margin; clothed with moderately prominent, yellowish pubescence, this more prominent laterally and on scutellum and clavus. Scutellum orange red to deep red; basal angles and median line more or less pale. Sternum and pleura pallid, red areas on mesosternum and metepisternum; ostiolar peritreme white. Hemelytra yellow, with clavus and basal half of corium and embolium red, but with many, pale yellowish spots, these spots forming a large triangular area before cuneus; embolium sometimes with small red flecks on apical half; cuneus, and part of corium extending beyond cuneal fracture, red; outer margin of cuneus with four yellow spots, these sometimes almost confluent. Membrane smoky to pale fuscous, slightly paler on apical half, veins red, usually pale at apices of areoles. Legs pale to yellowish, fore femora with red flecks at apices; hind femora with netlike, bright red markings, these somewhat broken at middle of apical half by a yellowish area; hind tibiae with reddish spots near base. Venter yellowish, with red flecks along dorsal margin; genital claspers and flagellum distinctive for species, fig. 179.

FEMALE.—Length 4.70, width 1.90; more robust than male, but very similar in color-

ation. Head width 0.86, vertex 0.36. Antennae, first segment, length 1.04; second, 2.47; third, 1.38; fourth, 1.17. Pronotum, length 0.74, width at base 1.38. More robust than male, but very similar in color and pubescence.

KNOWN DISTRIBUTION.—Alabama, Connecticut, District of Columbia, Illinois, Maryland, New York.

Illinois Record.—GALESBURG: July 24, 1892, 1 ♂, 6 ♀.

Phytocoris caryae Knight

Phytocoris caryae Knight (1923*d*, p. 652).

MALE.—Length 5.30, width 1.74. Head yellow, width 0.93, vertex 0.28; small spot at dorsal margin of each eye, irregular large spot on either side of front, and spot on dorsal margin of lora, orange colored; front and vertex bearing prominent, pale hairs. Rostrum, length 2.20, reaching fifth abdominal segment; pale yellowish, very dark brown at apex. Antennae, first segment, length 1.14, yellow, anterior aspect with small orange spots, largest one located near apex, setae pale to dusky; second, 2.46, uniformly pale yellow; third, 1.50, yellow; fourth, 1.16, yellow, dusky at apex. Pronotum, length 0.81, width at base 1.44; greenish yellow, with four orange stripes on disk, these sometimes joining at base; calli pallid, collar with broad orange spot located on either side of median line, these spots extending posteriorly to calli; propleura with small orange ray behind lower half of coxal cleft; clothed with pale yellowish pubescence, a few dusky hairs at basal margin. Scutellum greenish yellow, an oblique orange mark on either side of median line. Sternum and pleura pale yellowish. Hemelytra pale to greenish yellow, mottled with brown orange; darker on clavus, with many large, irregular greenish yellow spots; apical one-fifth of corium nearly uniformly greenish yellow; embolium with a few scattering red orange spots; tip of clavus with a dusky spot and beset with prominent black hairs; cuneus yellowish and translucent, apex and margins flecked with reddish; a prominent, dull reddish spot at margin between corium and membrane; clothed with yellow pubescence, this darker near apex of corium; emboliar margins very slightly arcuate. Membrane nearly colorless, with pale fuscous marbling, coloring darkest within areoles and at middle; veins dusky yellow at apices of areoles. Legs almost white to yellowish; apical halves of femora flecked with bright red, larger spots on posterior pair; tibial spines fuscous, hind pair with a small, reddish spot at base of each spine, although these spots obscure apically; tips of tarsi dusky. Venter pale greenish yellow; genital claspers and flagellum distinctive for species, fig. 179.

FEMALE.—Length 5.20, width 1.90. Head width 0.91, vertex 0.36. Antennae, first segment, length 1.21; second, 2.68; third, 1.51; fourth, 1.12. Pronotum, length 0.82, width at base 1.47. More robust than male, but very similar in color and pubescence.

HOST PLANT.—Hickory (*Carya* sp.).

KNOWN DISTRIBUTION. — Illinois and New York.

Illinois Records. — DUBOIS: Aug. 8, 1917, 1 ♂. GALESBURG: June 24, 1892, 1 ♀; July 29, 1892, 1 ♂, 4 ♀. MONTICELLO: June 28, 1914, Sangamon River, 1 ♂, 1 ♀. SAVANNA: July 23, 1892, McElfresh, 1 ♀.

Phytocoris puella Reuter

Phytocoris puella Reuter (1876, p. 69).

FEMALE.—Length 4.90, width 1.90. Head width 0.86, vertex 0.36; head pale, with mark on either side of collum extending upon collar; irregular arc either side of front, base of lora and dorsal half of bucculae, orange colored. Rostrum, length 2.26, extending to fifth ventral segment, pale, black at apex. Antennae, first segment, length 1.26, pallid, indistinctly dotted with orange on anterior aspect; second, 2.80, pale yellowish; third, 1.49, yellowish; fourth, 1.28, yellowish to dusky. Pronotum, length 0.78, width at base 1.40; pale, disk with four orange stripes, paler forms with stripes broken at middle; anterior angles with orange stripe which extends upon collar; propleura with orange ray crossing lower half of coxal cleft and extending nearly to posterior margin. Scutellum pale, with an oblique orange vitta on either side of apical half. Hemelytra pale, with rather uniform orange, netlike markings; cuneus partly red; hemelytra clothed with pale yellowish pubescence intermixed with prominent, white, silky pubescence. Membrane pale, areoles infuscated and marbled within apical half, veins yellowish, pale at apex of areoles. Legs pallid, front tibiae with two nearly obsolete, orange yellow bands; hind femora with red, netlike marks on apical half, di-

vided at middle of apical half by pallid annulus, fuscous hairs arising from red marks. Venter pallid, tinged with red near each spiracle.

MALE.—Length 4.80, width 1.51. Head width 0.85, vertex 0.21. Antennae, first segment, length 1.21; second, 2.81; third, 1.56; fourth, 1.21. Pronotum, length 0.73, width at base 1.25. Dorsum uniformly bright red, sometimes dotted with yellowish spots; calli pale; basal angles of pronotum and apex of scutellum yellowish to pale orange. Membrane pale smoky or nearly clear; areoles with rather fine, obscure, pale fuscous marks. Legs yellowish; apical half of hind femora with red, netlike markings and bearing fuscous to black hairs; a yellowish subapical band present; in this last respect very similar to female. Genital claspers, fig. 179. The sexes of *puella* exhibit a greater difference in color than do other, closely related species of this group.

HABITS.—Collected on oak (*Quercus* sp.) and red birch (*Betula nigra*).

KNOWN DISTRIBUTION.—Connecticut, District of Columbia, Illinois, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, New York, North Carolina, Ohio, Pennsylvania.

Illinois Records.—Eleven males and 20 females, taken June 12 to October, are from Anna, Ashley, De Soto, Dubois, Galena, Galesburg, Geff, Grand Detour, Harrisburg, Makanda, Marshall, Oregon, Palos Park, Starved Rock State Park, Urbana, White Pines Forest State Park. Blatchley (1926*b*, p. 729) records this species from Beverly Hills.

Phytocoris depictus Knight

Phytocoris depictus Knight (1923*d*, p. 654).

MALE.—Length 4.10, width 1.50. Head width 0.78, vertex 0.27; head marked with orange and red as in *puella* Reuter. Rostrum, length 1.93, reaching fifth abdominal sternite, yellowish, black at apex. Antennae, first segment, length 0.83, thickest near base and tapering to become more slender just before apex, yellowish, with a few red dots on anterior aspect and with seven or eight fuscous setae on basal half of dorsal aspect; second, 1.97, uniformly pale yellowish; third, 0.96, yellowish; fourth, 0.97, yellowish. Pronotum, length 0.71; width at base 1.23; pale testaceous and dusky; calli lighter; disk with four orange stripes; collar either side of median line and behind eye orange colored; clothed with pale yellowish pubescence, this fuscous near basal margin and sparsely intermixed with pale, silky pubescence; propleura with red mark crossing lower half of coxal cleft, this mark diffused behind cleft. Scutellum pallid, with orange mark either side of median line extending obliquely to lateral margin. Sternum pallid, episternum with red mark, epimeron chiefly red, ostiolar peritreme white, area just above reddish. Hemelytra with irregular, red, netlike markings, these produced by thickly placed and more or less confluent pale spots; basal half of corium nearly fusco-reddish; tip of clavus, and spot near inner basal angle of cuneus, black with prominent black hairs; clothed with golden yellow pubescence; central area with a few small spots of dense, silvery wool; cuneus bright red and with many rather small, pallid spots. Membrane pale fuscous; areoles and central area with clear spots; veins pale to fuscous. Legs pale to yellowish; apical two-thirds of hind femora dark red, with many large and small pallid spots, and an irregular, incomplete, pallid band at middle of apical half; a few black hairs arising from red area; spines on hind tibiae pallid, with reddish spot at base of each, except those spines at apex. Venter pale yellowish, with reddish dots on sides; base of genital segment fuscous; genital claspers and flagellum distinctive for species, fig. 179.

FEMALE.—Length 5.10, width 1.77. Head width 0.86, vertex 0.39. Antennae, first segment, length 1.04; second, 2.55; third, 1.21; fourth, 1.04. Pronotum, length 0.85, width at base 1.55. Larger and more robust than male, but very similar in coloration, although dorsum and membrane frequently with broader, light-colored areas.

HOST PLANT.—Bur oak (*Quercus macrocarpa*) and red oak (*Q. rubra*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Minnesota, New York, Ohio.

Illinois Records.—BEVERLY HILLS: Aug. 31, 1907, W. J. Gerhard, 2 ♀, FM. CARY: Aug. 27, 1905, W. J. Gerhard, 2 ♀, FM. FAIRFIELD: June 12, 1934, DeLong & Ross, 1 ♂. GIBSONIA: Oct. 2, 1934, Frison & Ross, 1 ♂. GOLCONDA: June 22, 1932, on oak, Ross, Dozier & Park, 1 ♂. KEITHSBURG: June 15, 1932, on red oak, H. L. Dozier, 1 ♂. SHAWNEETOWN: June 23, 1936, DeLong & Ross, 1 ♂.

Phytocoris luteolus Knight

Phytocoris luteolus Knight (1923*d*, p. 649). Known only from Alabama and Connecticut; not taken in Illinois.

MYRMECORINI

KEY TO GENERA

Length of first antennal segment greater than width of head; scutellum not conically produced, fig. 180; dorsum with fine, short pubescence ....**Paraxenetus**, p. 209
Length of first antennal segment much less than width of head, only slightly greater than width of vertex; scutellum conically produced, fig. 181; dorsum, especially pronotum and scutellum, with long, erect hairs ....**Barberiella**, p. 209

Paraxenetus Reuter

Paraxenetus guttulatus (Uhler)

Eucerocoris guttulatus Uhler (1887*d*, p. 150).

MALE.—Fig. 180. Length 6.40, width at base of cuneus, 1.33. Head width 1.00, vertex 0.27; sulcus on median line of vertex. Rostrum, length 2.42, extending slightly beyond posterior coxae or to second abdominal sternite. Antennae, first segment, length 1.46; second, 3.45; third, 2.85; fourth, 0.86; all segments slender, of nearly equal thickness, three basal ones yellowish to dusky brown, last segment reddish brown. Pronotum, length 0.95, width at base 1.34. Emboliar margins strongly sulcate, or medially coarctate. General color fusco-grayish, tinged with fulvous, sometimes fulvous areas broad; cuneus, veins of membrane, and calli, fulvous to reddish; femora frequently fusco-reddish. Body clothed with recumbent, fine yellowish pubescence, femora rather sparsely set with long pilose hairs, these hairs longest on posterior pair.

FEMALE.—Length 6.80, width 1.51. Head width 1.08, vertex 0.39. Antennae, first segment, length 1.51; second, 3.30; third, 2.94; fourth, 0.86. Pronotum, length 1.08, width at base 1.56. Very similar to male in form and coloration.

HOST PLANT.—Grape vines (*Vitis* sp.); one specimen collected in Illinois on walnut (*Juglans nigra*).

KNOWN DISTRIBUTION.—District of Columbia, Illinois, Indiana, Iowa, Maryland, Mississippi, Missouri, New Jersey, New York, Pennsylvania, Texas, Virginia.

Illinois Records.—COLLINSVILLE: Aug. 14, 1899, McElfresh, 1 ♀. DANVILLE: June 16, 1930, Frison & Hottes, 1 ♀. DUBOIS: July 3, 1909, 1 ♂. GRAFTON: July 20, 1932, on *Juglans nigra,* Ross & Dozier, 1 ♂. HAVANA: Aug. 15, 1907, Devil's Hole, 2 ♀. HEROD: July 24, 1930, Knight & Ross, 1 ♂. QUINCY: Aug. 8, 1889, 3 ♀; Aug. 11, 1889, 1 ♀.

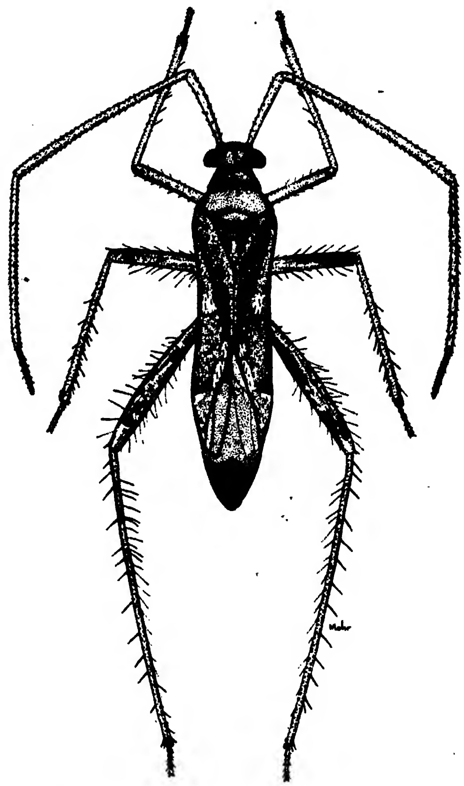


Fig. 180.—*Paraxenetus guttulatus,* ♂.

Barberiella Poppius

Barberiella apicalis Knight

Barberiella apicalis Knight (1923*d*, p. 657).

This species, fig. 181, is more closely related to *Fiebrigiella silvestri* Poppius, described from Brazil, than to *Barberiella formicoides* Poppius, but differs from the former, at least, in the longer first antennal segment and in the shining, brownish and

translucent apical area of the corium and embolium. The members of this genus are good ant mimics, and in their general aspect are very suggestive of the large species of *Pilophorus*.

Male.—Length 5.00, width 1.60. Head width 1.14, vertex 0.43; head almost vertical; vertex and base of front distinctly impressed along median line but not grooved; head very dark brown, clothed with pale pubescence, this more prominent on front. Rostrum, length 1.99, reaching bases of hind coxae, dark brown. Antennae, first segment, length 0.52, dark brown, with fine and dense pubescence and with two or three larger, erect hairs near apex, length of these less than thickness of segment; second, 2.03, cylindrical, slightly thicker than first segment, more slender near base, dark brown, with fine, dense pubescence; third, 1.11, slender, dark brown; fourth, 0.68, dark brown. Pronotum, length 1.24, width at base 1.59; anterior angles 0.84, anterior one-third nearly cylindrical to a point just behind calli, from thence flaring to posterior margin, but margin nearly a straight line; disk strongly convex; calli much reduced and with two impressed points between; very dark brown, darker anteriorly; surface leathery with pale pubescence and sparsely interspersed with erect, pilose hairs. Scutellum conically produced; point bent over and directed to the rear, fig. 181; sparsely set with long, pilose hairs; much of mesoscutum exposed, sloping downward to base of scutellum from which it is not distinctly separated; dark brown, moderately shining. Sternum and pleura dark brown; posterior half of epimeron white; ostiolar peritreme dark brown, with a protuberant point just above ostiole. Hemelytra with emboliar margins strongly constricted at middle, disk nearly flat; cuneus strongly declivitous; clothed with moderately sparse, golden yellow pubescence interspersed with more nearly erect fine hairs, these more prominent on clavus; clavus dull fusco-brownish, a triangular pruinose field extending upon middle from corium; corium fuscous on basal half; a transverse pallid spot at middle; behind this a dark fusco-brownish area extending as far as a line drawn transversely through tip of clavus; apical area chiefly pale brownish, somewhat translucent and shining, pruinose bordering the transverse dark band; cuneus uniformly brownish and translucent; membrane uniformly fusco-brownish, veins slightly darker. Legs uniformly dark brown, hind coxae with a pale or yellowish, opaque spot at antero-lateral angle; femora with coarse, leathery surface, sparsely clothed with erect, pale hairs; hind tibiae compressed, strongly curved, beset with yellow, spinelike hairs; tarsi fuscous, brownish at base. Venter black with a tinge of brown, moderately shining; strongly constricted at base, a pale mark on side just beneath that of corium; venter sparsely set with erect, pale hairs.

Fig. 181.—*Barberiella apicalis*, ♀.

Female.—Length 5.50, width before base of cuneus 1.59. Very similar to male in form and coloration; abdomen broader at apex. Head width 1.32, vertex 0.58. Antennae, first segment, length 0.54; second, 2.10, slender on basal half, clavate at apex (0.11 thick), exceeding thickness of first segment.

Known Distribution.—Illinois, Mississippi, New York, North Carolina.

Illinois Record.—Shawneetown: June 27, 1936, DeLong & Mohr, 1 ♀.

HOST LIST

Most species of Miridae are restricted to a single host plant or to a few closely related plants. Notable exceptions include the tarnished plant bug, *Lygus oblineatus* (Say), which may be found on almost any plant, and *Plagiognathus politus* Uhler, which occurs on a great many herbaceous plants. Both are so common and so diverse in their feeding habits that, to prevent repetition, neither is included under the various hosts in the following list. A number of mirids are predacious, but are associated with definite species of plants; in this list such mirids are indicated by an asterisk (*). Other species are possibly or probably predacious, at least in part, but are associated with definite plants; these are indicated by a dagger (†). Still other species have been collected on particular species of plants in sufficient numbers to make it probable that those plants are the food plants of the mirids, but the exact relationship existing between the mirids and the plants under which they are listed has not been demonstrated. Such species are indicated by a double dagger (‡). In species of Miridae not indicated by asterisk or dagger, the host relationship of the mirid and the plant species under which it is listed has been definitely established.

Acer negundo
‡*Paracalocoris scrupeus* (Say), 177
Plagiognathus negundinis Knight, 33
Acer rubrum
Coccobaphes sanguinareus Uhler, 138
Neolygus vitticollis (Reuter), 162
Acer saccharinum
Neolygus vitticollis (Reuter), 162
Acer saccharum
Coccobaphes sanguinareus Uhler, 139
Microphylellus elongatus Knight, 42
Neolygus hirticulus (Van Duzee), 163
Neolygus vitticollis (Reuter), 162
†*Phytocoris corticevivens* (Knight), 186
Acer spicatum
Neolygus belfragii (Reuter), 162
Acer sp.
**Deraeocoris nebulosus* (Uhler), 67
‡*Diaphnidia pellucida* Uhler, 92
**Phytocoris conspurcatus* Knight, 188
Achillea millefolium
Lopidea heidemanni Knight, 88
Achillea sp.
‡*Adelphocoris rapidus* (Say), 174
Agropyron repens
Capsus ater (Linnaeus), 138
Alder; see *Alnus*
Alder, smooth; see *Alnus rugosa*
Alder, speckled; see *Alnus incana*
Alfalfa; see *Medicago sativa*
Allium canadense
Labopidea allii Knight, 105
Allium cepa
Labopidea ainsliei Knight, 105
Labopidea allii Knight, 105
Allium cernuum
Labopidea ainsliei Knight, 105
Labopidea allii Knight, 105
Alnus incana
†*Deraeocoris alnicola* Knight, 70
Neolygus alni Knight, 157
Alnus rugosa
**Ceratocapsus decurvatus* Knight, 116
Ceratocapsus incisus Knight, 113
Ceratocapsus modestus (Uhler), 111
**Deraeocoris poecilus* (McAtee), 67
Neolygus clavigenitalis Knight, 163
Psallus alnicola Douglas and Scott, 44
Psallus fuscatus Knight, 44
Alnus sp.
†*Deraeocoris borealis* (Van Duzee), 71
‡*Diaphnidia pellucida* Uhler, 92
‡*Plagiognathus similis* Knight, 37
Althaea rosea
Melanotrichus althaeae (Hussey), 96
Ambrosia trifida
Lygus plagiatus Uhler, 153
Ambrosia sp.
Chlamydatus associatus (Uhler), 25
Chlamydatus suavis (Reuter), 26
Ilnacora malina (Uhler), 83
‡*Plagiognathus blatchleyi* Reuter, 35
Plagiognathus nigronitens Knight, 30
Plagiognathus politus Uhler, 29
Reuteroscopus ornatus (Reuter), 48
Reuteroscopus sulphureus (Reuter), 49
Amorpha canescens
Lopidea instabilis (Reuter), 91
Psallus amorphae Knight, 44
Amorpha fruticosa
Lopidea amorphae Knight, 90
Psallus amorphae Knight, 44
Anthemis cotula
Polymerus basalis (Reuter), 167
Apium graveolens
Lygus campestris (Linnaeus), 154
Apple; see *Pyrus malus*
Arbor vitae; see *Thuja occidentalis*
Arrow-wood; see *Viburnum*
Artemisia canadensis
Lygus atritibialis Knight, 152
Psallus bakeri (Bergroth), 45
Artemisia sp.
Psallus bakeri (Bergroth), 45
Artichoke; see *Helianthus tuberosus*
Arundinaria tecta
**Phytocoris arundinicola* Knight, 198
Asclepias sp.
‡*Ilnacora divisa* Reuter, 83
Macrolophus brevicornis Knight, 55
Ash; see *Fraxinus*
Ash, black; see *Fraxinus nigra*
Ash, red; see *Fraxinus pennsylvanica*
Ash, white; see *Fraxinus americana*
Aspen, American; see *Populus tremuloia*
Aspidium spinulosum
Monalocoris filicis (Linnaeus), 58
Aster, golden; see *Chrysopsis*
Aster macrophyllus
Microphylellus nigricornis Knight, 41

*Mirid predacious, but associated with the plant under which it is listed.
†Mirid possibly or probably predacious, but associated with the plant under which it is listed.
‡Mirid probably associated with the plant under which it is listed, but exact relationship of plant and mirid not demonstrated.

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Studies of
North American Plecoptera
With Special Reference to the Fauna of Illinois

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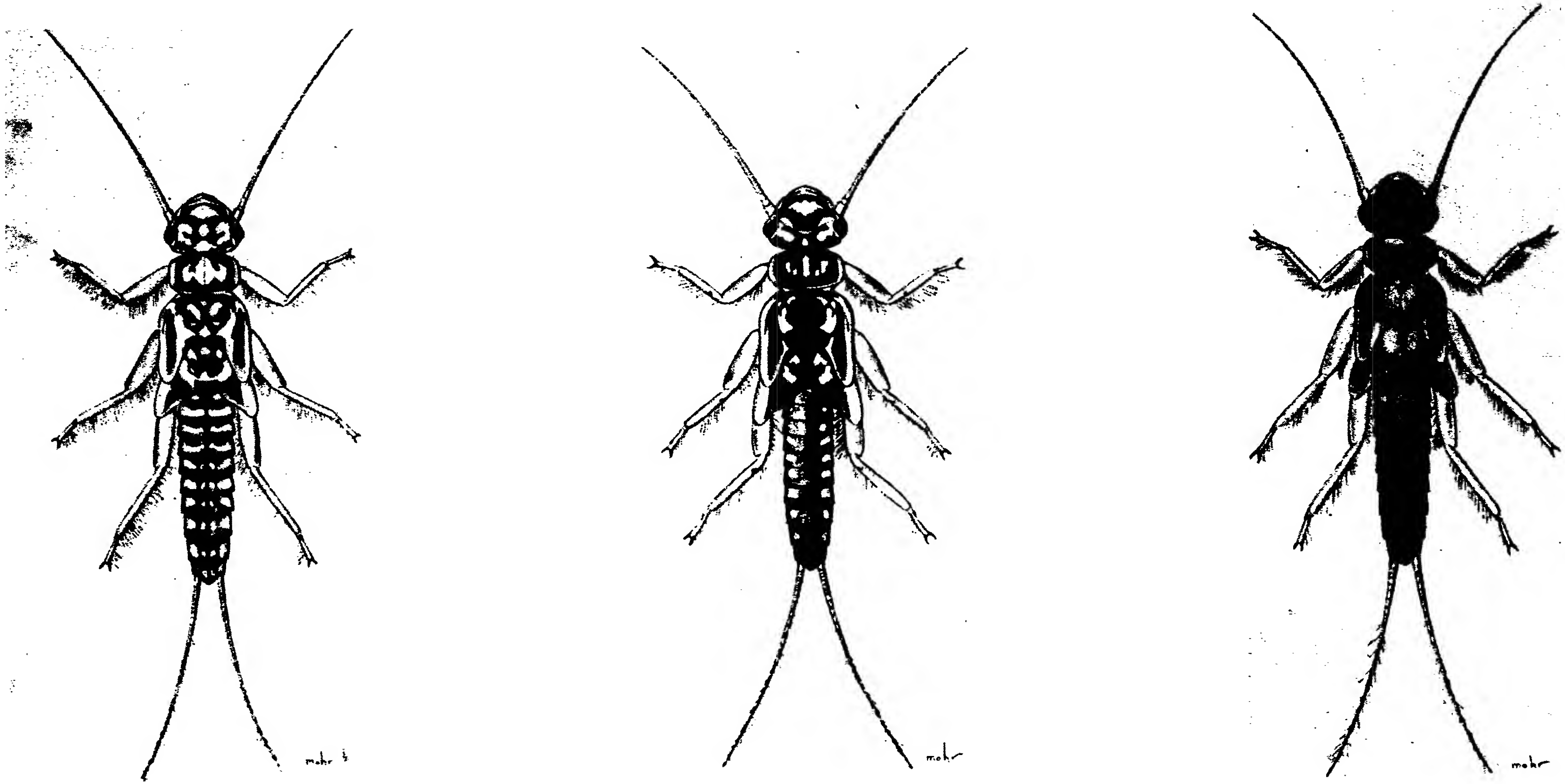


Nymphs of *Isoperla marlynia*. These three specimens exhibit marked variations in color pattern; yet they were collected at the same time and place and, based upon reared adult material, are unquestionably of the same species.

Studies of
North American Plecoptera

With Special Reference to the Fauna of Illinois

T. H. FRISON

THIS paper is a result of the continuance of studies of the stonefly fauna of Illinois started in 1926 and expanded within more recent years to include the fauna of North America. Three previous papers of mine have dealt entirely or in part with Illinois material of these aquatic insects; the first dealing with the fall and winter species only (1929), the second with all the then known Illinois species (1935*a*) and the third with additional information and recordings of species (1937).

In 1937 the Illinois list of stoneflies stood at 38 species plus a questionable identification of a capniid female and the nymph of a species of *Isoperla* not placeable to species. Studies of Illinois material since 1937 have revealed the identity of the capniid adult and the *Isoperla* nymph, and added nine additional species to the Illinois list.

Besides the study of Illinois Plecoptera, work has been in progress on the stonefly fauna of North America in general as a result of the availability of a large amount of adult and nymphal material submitted for identification by others or directly secured on collecting trips made by various members of the Illinois Natural History Survey staff. The Great Smoky Mountains National Park region and the states of Wisconsin and Michigan have been particularly singled out for collecting trips because of their nearness to Urbana, Ill., and the occurrence in them of numerous species not found in Illinois which are fairly representative of more northern and eastern sections of the United States and Canada. Numerous other collecting trips producing much material, trips often coupled with vacations or other duties, have been made by various staff members to almost all parts of the United States, with the exception of the southwestern states, and to southern Canada. In addition to collection of adult and nymphal stonefly material in quantity, considerable attention always has been given on these trips to the taking of mating pairs and the rearing of adults from nymphs. Some of the rearing of adults from nymphs has been done at the point of collection by the use of special rearing cages and by working at night to secure adults emerging from nymphs. Other nymphal material has been transported to Urbana from distant localities and then reared.

Another phase of activity in connection with the Survey's study of the stonefly fauna of North America has been the careful examination of existing types. The collections of the Museum of Comparative Zoology, Cambridge, Mass., and of Cornell University, Ithaca, N. Y., in addition to the Illinois Natural History Survey collection, are particularly rich in typic specimens of Plecoptera, and all of the North American types in these collections have been critically studied upon several occasions. The writer has also been privileged to study most of the other types of North American Plecoptera scattered here and there in various collections throughout the country.

The result of all this collecting, rearing, identification of material and study of types has naturally yielded much new information regarding the association of nymphs with adults, the distribution of

numerous species, the synonymy of certain species with others and the discovery of new species. In the present paper are the most important of these findings, with special emphasis upon a complete account of the fauna of Illinois.

Acknowledgments

I am indebted to many individuals and institutions for the donation or loan of material upon which this paper in part is based. Specimens of special importance have been donated or loaned by the following: Nathan Banks and F. M. Carpenter, Museum of Comparative Zoology, Cambridge, Mass.; J. Chester Bradley, C. McC. Mottley, J. G. Needham and Henry Dietrich, Cornell University, Ithaca, N. Y.; Gordon B. Castle, Montana State University, Missoula, Mont.; A. C. Cole, Jr., University of Tennessee, Knoxville, Tenn.; E. T. Cresson, Jr., Academy of Natural Sciences of Philadelphia, Philadelphia, Pa.; K. C. Emerson, Oklahoma Agricultural and Mechanical College, Stillwater, Okla.; P. W. Fattig, Emory University, Atlanta, Ga.; A. B. Gurney, U. S. Bureau of Entomology and Plant Quarantine, Washington, D. C.; John F. Hanson, Massachusetts State College, Amherst, Mass.; P. H. Harden, University of Minnesota, St. Paul, Minn.; Thelma Howell, Wesleyan College, Macon, Ga.; P. J. Jennings, Brooklyn, N. Y.; Stanley G. Jewett, Jr., Portland, Ore.; D. E. Kimmins, British Museum, London, England; Trevor Kincaid and Melville H. Hatch, University of Washington, Seattle, Wash.; Willis King, National Park Service, Gatlinburg, Tenn.; G. F. Knowlton, Agricultural Experiment Station, Logan, Utah; Mitsuko Kohno, Wakamatsu, Japan; J. W. Leonard, Institute for Fisheries Research, University of Michigan, Ann Arbor, Mich.; F. Earle Lyman, University of Michigan, Ann Arbor, Mich.; C. E. Mickel, University of Minnesota, St. Paul, Minn.; D. C. Mote and R. L. Post, Oregon State Agricultural College, Corvallis, Ore.; Ferris Neave, Pacific Biological Station, Nanaimo, B. C., Canada; A. Colin Nicol, University of Western Ontario, London, Ont., Canada; W. E. Ricker, Indiana University, Bloomington, Ind.; H. G. Rodeck, University of Colorado, Boulder, Colo.; W. M. Sprules, University of Toronto, Toronto, Ont., Canada; W. C. Stehr, Ohio University, Athens, Ohio; M. C. Tanner, Ogden, Utah.

H. H. Ross, B. D. Burks, G. T. Riegel and K. M. Sommerman, all staff members of the Insect Survey Section of the Illinois Natural History Survey, have greatly aided the preparation of this report by the collection of material, sorting and labeling of material and in numerous other ways. J. S. Ayars, Editor of the Survey, has materially assisted with the final reading, preparation and styling of this article.

I am particularly indebted, however, to C. O. Mohr, Associate Entomologist with the Survey, for almost all the splendid drawings which illustrate this article. Good drawings of the important structural details of the adult and nymphal stoneflies and dorsal views of the nymphs are, in certain respects, better for identification purposes than are word descriptions. Because of the excellent quality of these drawings, I have leaned heavily upon them in the writing of the descriptions.

Disposition of Material

All holotypes, allotypes and some of the paratypes of the species described as new in this article are deposited in the insect collection of the Illinois Natural History Survey at Urbana. Paratypes of some of the species are deposited elsewhere, as indicated in the typic records.

Much of the material listed in this paper is in the collection of the Illinois Natural History Survey. In some, but not all, instances in which material is in collections other than that of the Survey that fact is indicated, the following abbreviations being used for institutional collections.

M.C.Z.—Museum of Comparative Zoology of Harvard College, Cambridge, Mass.

C.U.—Cornell University, Ithaca, N. Y.

A.N.S.—Academy of Natural Sciences of Philadelphia, Philadelphia, Pa.

Arrangement of Subject Matter

In order to prevent treating various genera in two separate portions of this article, I have interwoven the subject

matter pertaining especially to Illinois with that relating to the North American fauna as a whole. As in my paper dealing with the stoneflies of Illinois as a unit (1935*a*), I have followed a presentation order beginning with the Pteronarcidae and ending with Chloroperlidae.

Revised Classification

In my paper dealing with the stoneflies of Illinois (1935*a*), I gave a discussion of the classification then proposed for the Plecoptera of North America, together with an outline showing the relationships of the various groups as I then accepted them. As might be expected in the development of a classification of a neglected order of insects, the study of extensive material since 1935, particularly from western states, has caused some modifications of my former views.

My present ideas regarding the classification of the North American Plecoptera down to generic groups are represented by the outline below.

This outline represents changes in my 1935 classification as follows: (1) reduction of genera in the family Taeniopterygidae to *Taeniopteryx* and *Brachyptera*, (2) removal of *Eucapnopsis* from the Leuctridae and its placement in the Capniidae, (3) addition to the Capniidae of the recently described genera of *Isocapnia*

REVISED CLASSIFICATION
OF THE PLECOPTERA OF NORTH AMERICA

PLECOPTERA	*HOLOGNATHA* or *FILIPALPIA*	PTERONARCIDAE	**Pteronarcys** **Pteronarcella**
		PELTOPERLIDAE	**Peltoperla**
		TAENIOPTERYGIDAE	**Taeniopteryx** **Brachyptera**
		NEMOURIDAE	**Nemoura**
		LEUCTRIDAE	**Leuctra** **Megaleuctra** **Perlomyia**
		CAPNIIDAE	**Capnia** **Allocapnia** **Capnura** **Eucapnopsis** **Isocapnia** **Nemocapnia**
	SYSTELLOGNATHA, *SUBULIPALPIA* or *SETIPALPIA*	PERLIDAE	**Atoperla** **Perlinella** **Neoperla** **Perlesta** **Acroneuria** **Neophasganophora** **Togoperla** **Claassenia**
		PERLODIDAE	**Perlodes** **Oroperla** **Isogenus** **Hydroperla** **Dictyopterygella** **Diploperla**
		ISOPERLIDAE	**Isoperla**
		CHLOROPERLIDAE	**Chloroperla** **Hastaperla** **Alloperla** **Paraperla** **Kathroperla**

and *Nemocapnia*, (4) addition of *Claassenia* to the Perlidae, (5) addition of *Dictyopterygella* to the Perlodidae, (6) the recognition of *Diploperla* as the generic name for a group of species formerly for the most part placed in *Perla* (*s.l.*), and its placement in the family of Perlodidae, (7) erection of a new family, the Isoperlidae, for the genus *Isoperla*, which I formerly placed in the Chloroperlidae, (8) recognition of *Oroperla* as a genus of Perlodidae and (9) removal of *Isoperla* from Chloroperlidae and the addition to this family of *Hastaperla*.

Some of the now accepted genera represent rather homogeneous groups of species, whereas other genera are quite heterogeneous and may contain several more or less minor complexes. Acceptance of these minor complexes within the larger generic units as subgenera will serve most nomenclatorial and classificatory needs. For instance, *Brachyptera* represents a genus containing several smaller complexes, most of which (*Nephopteryx*, *Obipteryx*, *Oemopteryx*, *Rhabdiopteryx*, *Strophopteryx*, etc.) have already been named and sometimes considered as genera. No phylogenetic relationships are lost or obscured by use of subgeneric names for such smaller complexes as *Oemopteryx*, for example, and the treatment of general entomological literature is often improved. The same applies to such genera as *Nemoura* and *Perlodes*. *Isoperla* (*s.l.*), as I now recognize it, contains several subgenera, some named and others unnamed. Almost any genus containing a number of species can be broken into finer subgeneric groups or complexes, but it is not the purpose of this article to go into detail concerning such classifications. Revisional papers dealing exhaustively with single families or genera are the best places for such lesser groupings to be defined and evaluated.

The groupings of the above species are subject to the personal factor in evaluation by individual specialists, and, like an accordion, the skeletal organizational scheme can be pulled out or contracted. Some students of stoneflies prefer to group the nemourids, leuctrids, capniids and taeniopterygids as subfamilies of a single large family, the Nemouridae. I prefer, however, at least for the present and until the world fauna is better known, to consider them as separate families. The actual problems of ready identification and keying remain the same regardless of which policy is followed. Future and broader studies of the world stonefly fauna will inevitably exert influences for some changes in existing classificatory systems.

REVISED KEY TO FAMILIES

of the Plecoptera of North America

(*Figures illustrating almost all of the characters used in these keys may be found in Frison 1935*a)

ADULTS

1. Anal area of forewings with two or more rows of crossveins; basal abdominal sternites with remnants of nymphal gills............ **Pteronarcidae**
   Anal area of forewings entirely without crossveins or with but one row; basal abdominal segments without remnants of nymphal gills.................... 2
2. Cerci short, not longer than greatest width of the pronotum.............. 3
   Cerci long, much longer than greatest width of the pronotum.............. 7
3. Forewings with numerous costal crossveins; the pronotum, as viewed from the side, lies at a downward sloping angle to the otherwise general horizontal plane of the mesothorax and metathorax; some species with gill remnants at least on sides of mesothorax and metathorax above bases of legs.................. **Peltoperlidae**
   Forewings with no or few costal crossveins; the pronotum, as viewed from the side, lies in the same general horizontal plane as the mesothorax and metathorax; without any gill remnants on sides of mesothorax and metathorax above bases of legs................ 4
4. Second tarsal segment about as long as other tarsal segments.................................... **Taeniopterygidae**
   Second tarsal segment much shorter than other tarsal segments................ 5
5. Cerci with five or six segments.............. **Capniidae** (*Eucapnopsis* only)
   Cerci one segmented.................. 6
6. Apical marginal space beyond tip of subcosta with an oblique crossvein; some species with gill remnants in cervical region.................... **Nemouridae**
   Apical marginal space beyond tip of subcosta without oblique crossvein; no gill remnants ever present in cervical region...................... **Leuctridae**
7. First tarsal segment long, about as long as the third tarsal segment; remnants of thoracic or submental gills never present; forewing with no or few median and cubital crossveins; females with a narrow or broad, pale, weakly sclerotized, median, longitudinal band on basal abdominal tergites distinctly contrasting with strongly sclerotized lateral margins; labium

with paraglossae and glossae extending forward about the same distance and arranged alongside of one another in same horizontal plane (Filipalpia type) .... **Capniidae**

First tarsal segment short, much shorter than third tarsal segment; remnants of thoracic or submental gills present or absent; forewing with from several to many median and cubital crossveins; females without a weakly sclerotized longitudinal band on basal abdominal tergites contrasting with strongly sclerotized lateral margins; labium, with paraglossae extending forward beyond glossae and so dominating glossae that the latter are much reduced (Subulipalpia type) 8

8. Remnants of branched filamentous gills on sides or venter of thorax, in position corresponding to location of branched filamentous gills in nymphs .... **Perlidae**

No remnants of nymphal branched filamentous gills on sides or venter of thorax, or if gill remnants are present they are single, not branched, finger-like processes (some **Perlodidae**) 9

9. Remnant of finger-like gills located near each side of outer basal corner of submentum .... **Perlodidae** (*Perlodes*, *Isogenus* and *Hydroperla*)

No remnant of finger-like gills located near each side of outer basal corner of submentum 10

10. Anal lobe of hindwing always present and large; anal lobe with 5 to 10 distinct veins, exclusive of first anal vein, reaching margin of wing; males with lobe on posterior margin of seventh or eighth, or sometimes both seventh and eighth, ventral abdominal segments except for *Dictyopterygella* 11

Anal lobe of hindwing usually present, but sometimes small and in *Hastaperla* lacking; anal lobe usually with but two to three distinct veins exclusive of first anal vein, except *Kathroperla* which may have six or seven, reaching margin of wing; males without a lobe on posterior margin of either seventh or eighth ventral abdominal segments .... **Chloroperlidae**

11. Males with lobe on posterior margin of seventh abdominal sternite, except in *Dictyopterygella* where all lobes are lacking and in *Diploperla luctuosa* which has lobe on eighth abdominal sternite; males with tenth abdominal tergite usually distinctly cleft, or if not distinctly cleft with subanal lobes projecting backward (*Dictyopterygella*) or with special terminal dorsal abdominal structures (*Diploperla luctuosa*, *D. duplicata* and *D. bilobata*); radial sector of forewing with from two to five branches, usually with three or more; subgenital plate of female usually well developed, large and frequently covering most of eighth abdominal sternite .... **Perlodidae** (*Dictyopterygella* and *Diploperla*)

Males without a lobe on posterior margin of seventh ventral abdominal segment but with such a lobe varying in size from small to large, always on eighth abdominal sternite; males with tenth abdominal tergite never distinctly cleft; radial sector of forewing with from two to four branches, but usually with two; subgenital plate of female sometimes not developed, and when present usually not covering most of the eighth abdominal sternite .... **Isoperlidae**

NYMPHS

1. Gills present on some of the ventral basal abdominal segments .... **Pteronarcidae**

Gills absent on all ventral abdominal segments 2

2. Venter of thorax covered with large, overlapping, shieldlike plates .... **Peltoperlidae**

Venter of thorax without distinct, large, overlapping, shieldlike plates 3

3. Labium with paraglossae and glossae extending forward about the same distance and side by side in the same horizontal plane 4

Labium with paraglossae extending forward much farther than the glossae, the latter deeply inset below and between the paraglossae so as to appear almost as basal segments of them 7

4. Second tarsal segment approximately as long as or longer than the first segment .... **Taeniopterygidae**

Second tarsal segment shorter than the first 5

5. Small and robust nymphs, hairy; hindwing pads extending considerably outward from the body at an angle; gills present or absent in ventral cervical region .... **Nemouridae**

Small and slender nymphs; hairs few, fine or lacking; hindwing pads lying about parallel to longitudinal axis of body; no branched cervical gills 6

6. Lateral margins of abdominal segments somewhat rounded, segments widest at posterior margin and narrower toward base; hindwing pads with anal lobe or area extending far beyond middle of wing pad; forewing pads of males sometimes entirely lacking; last abdominal segment in males sometimes with a conical projection .... **Capniidae**

Lateral margins of abdominal segments almost straight, abdomen appearing more cylindrical; each hindwing pad with anal lobe or area small and not extending much beyond middle of wing pad; forewing pads of males always present; last abdominal segment in males without a conical projection.. .... **Leuctridae**

7. Branched filamentous gills on sides and venter of thorax .... **Perlidae**

Without branched filamentous gills on sides or venter of thorax............ 8

8. With a small membranous finger-like

gill located near each side of outer basal angle of submentum....**Perlodidae** (*Perlodes, Isogenus* and *Hydroperla*)

Without such gill on submentum....... 9

9. Lateral margins of forewing pads approximately straight or in line with longitudinal body axis; tip of lacinia with one or more teeth; diameter of fourth segment of maxillary palpus not much greater than base of fifth segment; nymphs frequently with a conspicuous color pattern on dorsum of abdomen 10

Lateral margins of forewing pads rounded; tip of lacinia never with more than one tooth; diameter of fourth segment of maxillary palpus often much greater than base of fifth segment; nymph without conspicuous color pattern on dorsum of abdomen (sometimes color pattern of adult ready to emerge is evident through nymphal skin)..........**Chloroperlidae**

10. Maxillae bulging out from sides of head in a very conspicuous manner; diameter of lacinia from base to apex tapers very rapidly, and it forms a long single claw or a long claw plus a secondary one; color pattern of abdominal tergites suffused or with distinct transverse markings..............................**Perlodidae** (*Diploperla*)*

Maxillae not or but slightly bulging out from sides of head; diameter of lacinia from base to apex less tapering, structure in general of more stocky form with smaller teeth or tooth at apex; color pattern of abdominal tergites suffused or with distinct longitudinal markings...........**Isoperlidae**

Revised List of Illinois Species

The number of species of stoneflies now known to be found in Illinois represents a great increase over the numbers in all former lists. In briefly reviewing the growth of the Illinois faunal list it will suffice to quote from my papers of 1935*a* and 1937.

In 1935 I wrote: "A revised tabulation of the species recorded by Walsh from the vicinity of Rock Island in 1862 gives us a present list of 15 species. In the tabulation of species by states as given by Needham and Claassen (1925), Illinois is credited with 14 species, but since two species of *Pteronarcys* are listed whereas all our evidence indicates but one, this list of 1925 includes only 13 species. If all the Walsh records had been placed by Needham and Claassen their list would have given 17 species for this state. Our studies to date give us a total of 36 species of stoneflies for Illinois plus at least two and possibly a third species as yet known only as nymphs and not placeable to species at the present time—a list more than double those of Walsh or Needham and Claassen.

"The status of two *Acroneuria* nymphs and another nymph which I am tentatively placing as *Neophasganophora* needs to be definitely established. Two of these, one *Acroneuria* and the *Neophasganophora*, are certainly species which are additions to our list. The second *Acroneuria* nymph now unnamed may represent a light phase of a species already reared and known, but there is also a possibility that it may be new to our list."

In 1937 I wrote: "These specific placements [assignment of specific names, based upon rearings, to two species known only from unidentifiable nymphs in 1935*a*] bring the total of Illinois stoneflies to 38, with the certainty that two additional species will be added by future studies, one a questionable identification of a female *Capnia* as *vernalis* Newport and the other an *Isoperla* represented as yet by a single nymph not placeable to species."

The rearing and collecting of Illinois material since 1937, together with the rearing and collecting of material from other states, have now expanded the Illinois faunal list to 49 species, which is greater than the number recorded for any other state except New York. The New York list of 1928 contained 59 recorded species, but at least two of these names are involved in the synonymy of other listed names. Additional species have been collected in New York since then, and the final list has possibilities of some 60 species.

The Illinois list may eventually be augmented by a few additional species, but our field work has been so comprehensive that but few species can possibly be added. No Illinois nymphs are now known which cannot be placed to species. Of species known to occur in adjacent states, *Acroneuria areta, Isoperla dicala* and *Isoperla namata*, all described in this paper, may sometime be taken in Illinois. *Acroneuria areta* is found in the Ohio River basin, and specimens are a possibility at points along the boundary waters of the Ohio River in southern Illinois. *Isoperla namata* has been taken in two states, Indiana and Missouri, adjacent to southern Illinois and thus may eventually be found within

*Nymph of *Dictyopterygella* when found will probably key out at this place.

our borders, but several streams which seemed to present possibilities of harboring this species have not thus far produced any specimens. *Isoperla dicala* has been taken in northern Indiana, and the upper parts of the Kankakee River basin in Illinois present possibilities for finding this species. *Isoperla duplicata* and *Leuctra sara* have been found in Indiana about 30 miles east of the border of central Illinois. Then the chance of finding some other species, not to be considered as a possibility based on present distributional records, can never be entirely excluded.

Of the North American families of stoneflies recognized by me, Illinois lacks representatives of but a single family, the Peltoperlidae. The nymphs of species belonging to this family are found in cold streams in mountainous or northern states, and it is unlikely that a species of this family will ever be found in Illinois.

REVISED LIST OF THE PLECOPTERA OF ILLINOIS

Together With Illinois Literature Citations

PTERONARCIDAE
- **Pteronarcys** Newman
  - *Pteronarcys pictetii* Hagen
    - Frison 1935*a*, p. 336 (*nobilis*)

TAENIOPTERYGIDAE
- **Taeniopteryx** Pictet
  - *Taeniopteryx maura* (Pictet)
    - Frison 1935*a*, p. 341 (*nivalis*)
  - *Taeniopteryx parvula* Banks
    - Frison 1935*a*, p. 345
  - *Taeniopteryx lita* Frison
    - Present paper, p. 249
- **Brachyptera** Newport
  - *Brachyptera fasciata* (Burmeister)
    - Frison 1935*a*, p. 347

NEMOURIDAE
- **Nemoura** Latreille
  - *Nemoura venosa* Banks
    - Frison 1935*a*, p. 349
  - *Nemoura trispinosa* Claassen
    - Present paper, p. 261

LEUCTRIDAE
- **Leuctra** Stephens
  - *Leuctra claasseni* Frison
    - Frison 1935*a*, p. 354
  - *Leuctra decepta* Claassen
    - Present paper, p. 257
  - *Leuctra tenuis* (Pictet)
    - Present paper, p. 258

CAPNIIDAE
- **Capnia** Pictet
  - *Capnia opis* (Newman)
    - Present paper, p. 264
- **Nemocapnia** Banks
  - *Nemocapnia carolina* Banks
    - Frison 1935*a*, p. 356 (*Capnia vernalis* ?, ♀)
- **Allocapnia** Claassen
  - *Allocapnia forbesi* Frison
    - Frison 1935*a*, p. 363
  - *Allocapnia forbesi* var. *cornuta* Frison
    - Frison 1935*a*, p. 363
  - *Allocapnia granulata* (Claassen)
    - Frison 1935*a*, p. 364
  - *Allocapnia illinoensis* Frison
    - Frison 1935*a*, p. 365
  - *Allocapnia mystica* Frison
    - Frison 1935*a*, p. 366
  - *Allocapnia pygmaea* (Burmeister)
    - Present paper, p. 265
  - *Allocapnia recta* (Claassen)
    - Frison 1935*a*, p. 367
  - *Allocapnia vivipara* (Claassen)
    - Frison 1935*a*, p. 370
  - *Allocapnia rickeri* Frison
    - Frison 1935*a*, p. 367 (*pygmaea*), and present paper, p. 269

PERLIDAE
- **Atoperla** Banks
  - *Atoperla ephyre* (Newman)
    - Frison 1935*a*, p. 377
- **Perlinella** Banks
  - *Perlinella drymo* (Newman)
    - Frison 1935*a*, p. 380
- **Neoperla** Needham
  - *Neoperla clymene* (Newman)
    - Frison 1935*a*, p. 381
- **Perlesta** Banks
  - *Perlesta placida* (Hagen)
    - Frison 1935*a*, p. 386, and present paper, p. 271
- **Acroneuria** Pictet
  - *Acroneuria abnormis* (Newman)
    - Frison, 1935*a*, p. 391
  - *Acroneuria internata* (Walker)
    - Frison 1935*a*, p. 401
  - *Acroneuria ruralis* (Hagen)
    - Frison 1935*a*, p. 403
  - *Acroneuria evoluta* Klapálek
    - Frison 1935*a*, p. 395 (*arida*), and present paper, p. 273
  - *Acroneuria mela* Frison
    - Frison 1935*a*, p. 405 (*Acroneuria* sp. *a*), and 1937, p. 79 (*evoluta*)
  - *Acroneuria perplexa* Frison
    - Frison 1937, p. 79
- **Neophasganophora** Lestage
  - *Neophasganophora capitata* (Pictet)
    - Frison 1935*a*, p. 409
- **Togoperla** Klapálek
  - *Togoperla media* (Walker)
    - Frison 1935*a*, p. 412
  - *Togoperla kansensis* (Banks)
    - Frison 1937, p. 82, and 1935*a*, p. 414 (*Togoperla* sp. *a*)

PERLODIDAE
- **Hydroperla** Frison
  - *Hydroperla crosbyi* (Needham & Claassen)
    - Frison 1935*a*, p. 419
  - *Hydroperla harti* Frison
    - Frison 1935*a*, p. 423
  - *Hydroperla varians* (Walsh)
    - Frison 1935*a*, p. 426, and 1937, p. 82

CHLOROPERLIDAE

Hastaperla Ricker

Hastaperla brevis (Banks)
Frison 1935*a*, p. 431 (*cydippe*), and present paper, p. 340

Alloperla Banks

Alloperla caudata Frison
Present paper, p. 342

Alloperla banksi Frison
Present paper, p. 343

ISOPERLIDAE

Isoperla Banks

Isoperla bilineata (Say)
Frison 1935*a*, p. 437

Isoperla confusa Frison
Frison 1935*a*, p. 441

Isoperla conspicua Frison
Frison 1935*a*, p. 445

Isoperla decepta Frison
Frison 1935*a*, p. 447

Isoperla minuta (Banks)
Frison 1935*a*, p. 453

Isoperla mohri Frison
Frison 1935*a*, p. 455

Isoperla richardsoni Frison
Frison 1935*a*, p. 459

Isoperla marlynia Needham & Claassen
Frison 1935*a*, p. 439 (*clio*), and present paper, p. 330

Isoperla burksi Frison
Present paper, p. 332

Isoperla longiseta Banks
Present paper, p. 318

PTERONARCIDAE

Because of their large size for stoneflies, gill remnants on adults and general distribution, the species of *Pteronarcys* have long attracted the fancy of students of insect life. In spite of all the work done to date, however, there remain taxonomic problems and gaps in our knowledge which can be solved only, or best, by the rearing of series of specimens from numerous localities.

One of the problems confronting the writer has been the determination of the number of eastern North American species in the complex in which the nymphs lack the lateral lobes or hooks on the sides of the abdomen. This, in turn, has led to some discoveries regarding existing nomenclatorial matters. My conclusions to date regarding these matters are presented under the headings of *Pteronarcys dorsata* (Say) and *pictetii* Hagen.

The bibliography and synonymy listed for *dorsata* and *pictetii* do not include all references to these two species in literature, but these listings do account for all references involving synonymy and nomenclatorial problems. It is a fairly safe assumption that all American references since Smith (1917) for *dorsata* should now be associated with *dorsata* and those for *nobilis* Hagen should now be associated with *pictetii.*

Pteronarcys dorsata (Say)

Sialis dorsata Say (1823, p. 164). Original description.

Pteronarcys regalis Newman (1838*a*, p. 176). Previous synonymy accepted.

Kollaria insignis Pictet (1841, p. 123). Previous synonymy accepted.

Pteronarcys nobilis Hagen (1861, p. 15). New synonymy.

Pteronarcys proteus Hagen (1861, p. 14). New synonymy.

Pteronarcys regalis Hagen (1873, p. 286). Previous synonymy accepted.

Pteronarcys nobilis Hagen (1873, p. 285). New synonymy.

Pteronarcys frigida Gerstaecker (1873, p. 65). Previous synonymy accepted.

Pteronarcys rectus Provancher (1876, p. 189). Previous synonymy accepted.

Pteronarcys flavicornis Provancher (1876, p. 191). Previous synonymy accepted.

Pteronarcys nobilis Klapálek (1907, p. 153). New synonymy.

Pteronarcys dorsata Needham & Claassen (1925, p. 35).

Pteronarcys shelfordi Frison (1934, p. 25). Placed in synonymy of *frigida* by Ricker (1938, p. 130).

In her revisional paper dealing with the North American species of Pteronarcinae and Perlodini, Smith (1917) established the association of the specific name of *dorsata* with a common northeastern species of *Pteronarcys* which in the female has the posterior margin of the eighth abdominal sternite straight and in the male has the tips of the lobes of the tenth abdominal tergite bent upward. This concept of *dorsata* may or may not represent the species actually described by Say, but this interpretation of Say's species was accepted by Needham & Claassen (1925); there is no good reason for not following, and from the standpoint of stability of names there is good reason for favoring, the perpetuation of this earlier nomenclatorial decision.

It is unfortunate, however, that, when adopting the use of the name *dorsata*, Smith (1917) did not correctly interpret *nobilis* Hagen (1861). The female of *nobilis* in the original description is characterized as having the "♀ antepenultimate one [ventral segment] truncated, orange, two short setiform appendages?

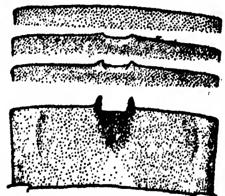
(they cannot be clearly seen)." In view of this suggestive description, it is surprising that the name of *nobilis* was associated by Smith (1917) with a species which has the eighth abdominal sternite distinctly incised in the middle of its posterior margin. Needham & Claassen (1925) followed Smith, and, previous to a close study of the types of *nobilis*, this use of names was accepted by me (1935*a*).

In the Museum of Comparative Zoology, there are two specimens, one male and one female, labeled as the types of *nobilis* and assigned the type number of "241." Upon two occasions I have studied these types in considerable detail, and upon another occasion had them independently studied for me by Dr. H. H. Ross of the Illinois Natural History Survey. The typic female specimen has associated with it on the insect pin the data, "*P. nobilis* Hagen-Winthem-Hagen," and the typic male the data, "New York–Winthem-Hagen." Neither the typic male nor the typic female corresponds to the use of *nobilis* as defined by Smith (1917) and followed by Needham & Claassen (1925) and subsequently by me (1935*a*). The typic female has the posterior margin of the eighth abdominal sternite straight and thus corresponds with the "truncated" part of Hagen's original description and the species *dorsata* as now accepted. The "two short setiform appendages" questionably mentioned by Hagen (1861) do not now show in the pinned specimen, and later Hagen (1873) states, "There are no appendages (as I described with a ? in my Synopsis)." Even if these appendages were present, as I shall show in a following paragraph, they would not preclude this typic female being placed in the synonymy of *dorsata*. The typic male, likewise, has the lobes of the tenth abdominal tergite slightly turned upwards as in *shelfordi* Frison and *dorsata*, and most certainly not downwards as in *nobilis* as used by Smith (1917). Since all evidence points to the male and female specimens labeled as types "No. 142" being the true types, it must follow that *nobilis* should be placed in the synonymy of *dorsata*.

Unaware of certain characters of *frigida* Gerstaecker (1873) from Labrador, previously sunk as a synonym of *dorsata* by Smith (1917), I described *shelfordi* in 1934 from Fort Churchill on Hudson's Bay. Ricker (1938), after a study of Gerstaecker's type, came to the conclusion that *shelfordi* was a synonym of *frigida*, and I now accept the view that these two are of the same species.

It is also now my view that *shelfordi* is the same as *dorsata* and that the differences originally used by me (1934) to

Fig. 1.—*Pteronarcys dorsata.*



separate the two are attributable to variation. This view was gradually formed by the study of considerable adult *Pteronarcys* material and by repeated attempts to separate to species the nymphs belonging to this same complex of species (lacking lateral hooks on sides of abdomen). My suspicions that *shelfordi* (= *frigida*) intergraded with *dorsata* were definitely confirmed by the rearing of a series of adults from nymphs found climbing out of the water in the Pere Marquette River near Baldwin, Mich., on May 19, 1940. Fig. 1 shows the posterior margins of the eighth abdominal sternites of adult females reared at this time. It can be seen from this figure that there is intergradation in the same locality between females of the *dorsata* and *shelfordi* types, and they should not be accepted as distinct species. When *shelfordi* was originally described I was not aware of the shape of the eighth abdominal sternite in the females of *frigida*, and as a result of Smith's (1917) paper I assumed that all the names placed in synonymy of *dorsata* referred to females having the posterior margin of the eighth abdominal sternite straight without small projections.

Distributional records do tend to indicate, however, that specimens of *dorsata* having the eighth abdominal sternite straight are more nearly confined to the southern part of the range of this species, and those with two small projections on the eighth sternite (*frigida* and *shelfordi* types) prevail in the northern part of its range.

I am accepting Smith's (1917) placement of *Kollaria insignis* Pictet (1841), *Pteronarcys regalis* Newman (1838), *P. rectus* Provancher (1876), *P. flavicornis* Provancher (1876) and *P. frigida* Gerstaecker (1873) as synonyms of *dorsata*. Klapálek (1907) has shown that *insignis* is the same as *regalis*, and *regalis* is a synonym of *dorsata*, as a result of Smith's interpretation of Say's species. Ricker (1938) further confirms synonymy of *insignis* with *dorsata* based upon study of the type of the former.

In 1939, I studied the specimens in the Provancher collection now in the Provincial Museum, Quebec, Canada, in hopes of definitely locating types of *rectus* and *flavicornis*. In this collection I found one female and one male *Pteronarcys* associated with the label of "*P. regalis*," and both are specimens of *dorsata* as I now recognize this species. Another female *Pteronarcys* standing associated with the name "*rectus*" may be a type, and it also is *dorsata*. All specimens of *Pteronarcys* now in the Provancher collection tend to confirm the correctness of placing these names *rectus* and *flavicornis* in the synonymy of *dorsata* as done by Smith (1917).

It should be mentioned here that Hagen's 1861 record for *proteus* and his 1873 record for *nobilis* should be placed in the bibliography of *dorsata* since Hagen in 1873 states that the specimens recorded by him in 1861 as *proteus* are *regalis* (= *dorsata*). Smith (1917) thus erred in placing Hagen's (1861) reference to *proteus* under *proteus* when it should go under *dorsata*. Also, Klapálek's (1907) reference to *nobilis* should be placed in the synonymy of *dorsata* and not under *pictetii* (= *nobilis*) as done by Smith.

As mentioned in an earlier paragraph, I am placing *regalis* in the synonymy of *dorsata* because of reared females from the same locality which show all stages between having a straight posterior margin of the eighth abdominal sternite and having two conspicuous nipple-like processes. Hagen's (1873) report seems to be quite definite in regard to *regalis* having these nipple-like processes.

Pteronarcys pictetii Hagen

Pteronarcys pictetii Hagen (1873, p. 286). Original description, ♂, ♀.

Pteronarcys regalis Hagen (1861, p. 15). New synonymy for ♀.

Pteronarcys nobilis Smith (1917, p. 448). New synonymy.

Pteronarcys nobilis Needham & Claassen (1925, p. 36). New synonymy.

Pteronarcys nobilis Frison (1935*a*, p. 336). New synonymy.

Under the discussion of *dorsata* (Say) I have shown that *nobilis* Hagen is the species called *dorsata* by Smith (1917), and that *regalis* Newman (1838*a*) is a variant of *dorsata*.

The types of *pictetii* are now in the Museum of Comparative Zoology, associated with the type number "242." The female has labels associated with it as follows: "Philadelphia — Winthem — Hagen." The male has associated with it the following data: "Meadville—Pa.—B. P. Mann." In view of the fact that the male type is the species *dorsata*, I hereby designate the female type as the **lectotype** to govern the use of the name *pictetii*.

A study of these types reveals that *pictetii* is the species called *nobilis* by Smith and was so synonymized by her. However, since Smith's concept of *nobilis* was in error, the name of *pictetii*, by selection of typic female as **lectotype**, is the first name available to be used for the species called *nobilis* by Smith (1917), Needham & Claassen (1925) and Frison (1934 and 1935*a*).

Hagen's (1873) paper clearly corrected his earlier mistakes of 1861 regarding *Pteronarcys*, but he had no means of knowing that his *nobilis* and *regalis* would be found to intergrade and that *dorsata* would later be considered a species of *Pteronarcys* having name priority over both *nobilis* and *regalis*.

I have been unable thus far to find definite workable characters for separating the nymphs of *dorsata* and *pictetii*. At one time I thought that more distinctive striping of the nymphal abdomens indicated *dorsata*, but rearings have not confirmed this view, and the character of the water seems to have a marked influence upon the appearance of the nymphs. Mature female nymphs of *pictetii* can often be identified because of a strong indication of the incised posterior margin in the middle of the eighth abdominal sternite.

Ricker (1938), in his remarks regarding *Pteronarcys pictetii*, implies that the type of *pictetii* is a specimen called *proteus*

by Pictet (1841) and is in the Zoological Museum, Berlin, Germany. Pictet's specimen may be in the Zoological Museum in Berlin, but the types of *pictetii* are in the Museum of Comparative Zoology, as already stated.

Pteronarcys species

In New Brunswick in 1939, a series of nymphs of *Pteronarcys* was taken which cannot be reliably assigned to any species known at this time. Since then a similar nymph has been collected in Connecticut. The nymph, fig. 2, because of lateral projections on the sides of the first eight abdominal segments, is suggestive of the nymph at present associated with the species *biloba* Newman and *proteus* Newman. Of these two species it most closely resembles the nymph now assigned to *biloba* because of the more prominent lateral lobes and the more sharply angled anterior corners of the pronotum. It differs from *biloba,* however, in that the lateral abdominal projections are much more developed except on the first and eighth segments, that there is a very prominent projection on each side of the mesonotal wing pad, and that the projections at the corner angles of the pronotum are abnormally prominent.

There is considerable question as yet regarding the true status of *Pteronarcys comstocki* Smith, and it is possible that the nymph now illustrated should be associated with this name. Reared material is needed to settle this and other points involved with the correct determination of several species of *Pteronarcys.*

Data associated with these specimens are as follows.

CONNECTICUT.—MOUNT CARMEL, Mill River, Sleeping Giant State Park: Oct. 14, 1941, K. M. Sommerman, 1 nymph.

NEW BRUNSWICK.—PENOBSQUIS, crawling on rocks in small clear stream: Aug. 20, 1939, T. H. Frison & T. H. Frison, Jr., 18 nymphs.

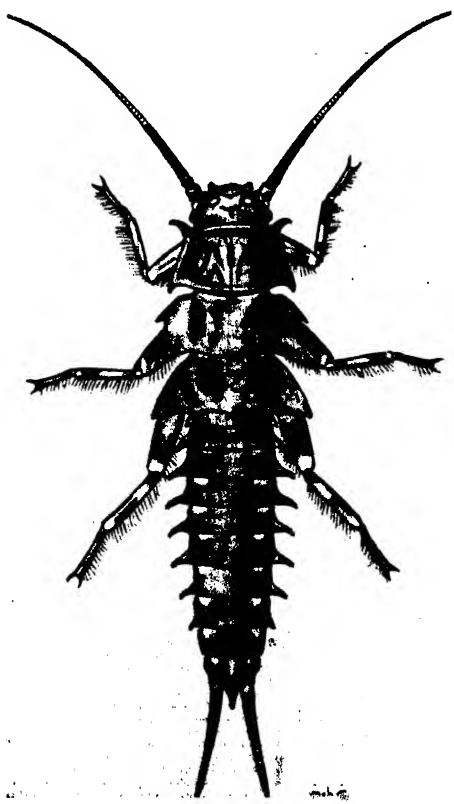


Fig. 2.—Nymph of *Pteronarcys* species.

PELTOPERLIDAE

This family is exceedingly interesting to the student of stoneflies because of its many unique features, including the strikingly roachlike appearance of the nymphs.

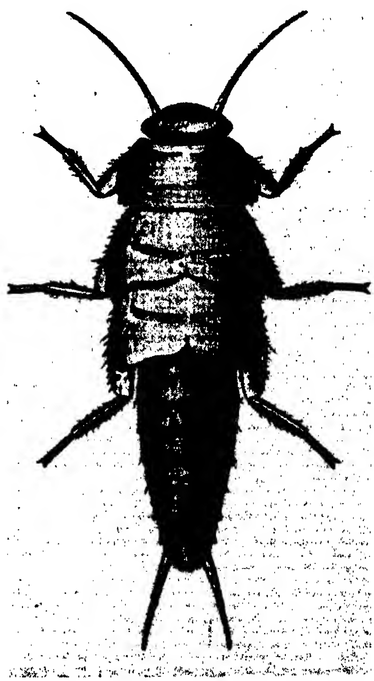


Fig. 3.—Nymph of *Peltoperla brevis.*

Few records of the various described species occur in literature, and the general taxonomy of the group is far from satisfactory because of the lack of reared material and series of associated males and females, and because of certain weaknesses in existing specific descriptions.

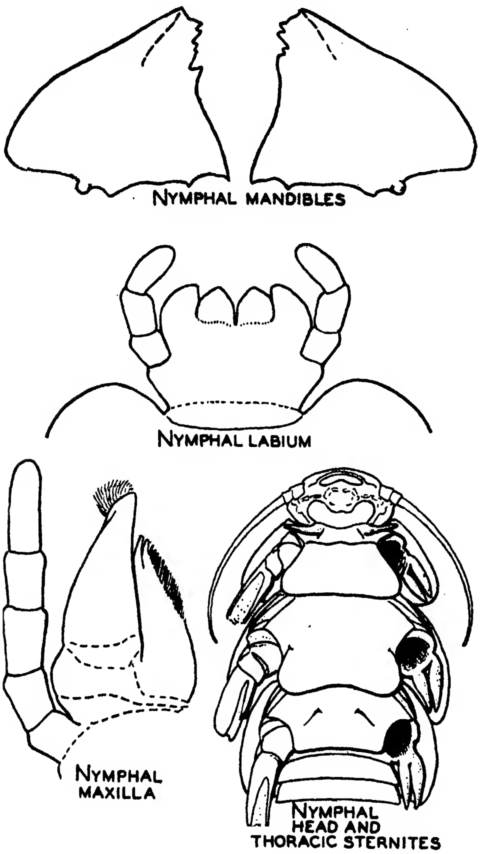


Fig. 4.—*Peltoperla brevis.*

The character, number and location of the gills in the nymphs, and remnants of these in the adults, are certain to prove of great value in future work of identification. Claassen (1931) has given a good description of *Peltoperla arcuata* Needham nymphs based upon reared material. This nymph has five pairs of filamentous gills, one pair each side near upper point of attachment of each mesothoracic leg, one pair each side near upper point of attachment of each metathoracic leg, and one pair on the underside of the metasternum. Nymphs in the Illinois Natural History Survey collection which certainly belong to *P. brevis* (Banks), fig. 3, have six pairs of gills, one pair near upper point of attachment of each leg and none beneath the metasternum, fig. 4. These differences in number and arrangement of gills indicate the taxonomic value of these characters, and they need to be carefully observed in all species. Dorsal view of the nymph is illustrated in fig. 3.

As in other adults whose nymphs have gills, the adults of *Peltoperla* show gill remnants when examined closely. I have noted, however, that adults of *Peltoperla* have membranous filaments on the dorsal thoracic segments which cannot be associated with gills in the nymphs. These false gill-like appendages appear to be remnants of membranous tissue, an appearance occasioned by the peculiar shieldlike thoracic segments of the nymphs.

Peltoperla arcuata Needham

Peltoperla arcuata Needham (1905, p. 108). Original description, ♀.
Peltoperla arcuata Needham & Claassen (1925, p. 170). Description, ♂.

This species was originally described from a female; the description of the male appeared later. Since the description of the male of this species by Needham & Claassen (1925) does not mention the peculiar shape of the anal cerci, I present three illustrations, fig. 5, which show their shape. These illustrations are based upon a specimen from Ithaca, N. Y., in the Cornell University collection, recorded by Needham & Claassen (1925). The figure presented by these authors for the male

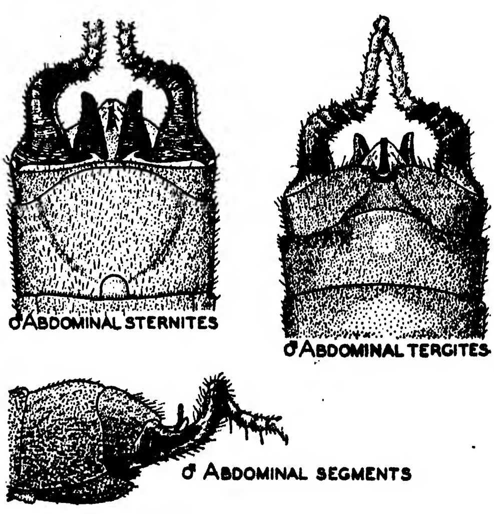


Fig. 5.—*Peltoperla arcuata.*

gives but slight indication of the manner in which the anal cerci bend inward near their bases, and, without mention of this unusual character in the text, its significance is lost.

Peltoperla zipha new species

MALE.—Body, legs and cerci pale yellowish brown, with dorsum of head and thorax darker brown; with basal segments of antennae concolorous with head and with apical segments darker. Compound eyes and ocelli black and contrasting with head.

Head through compound eyes not so wide as anterior margin of pronotum, with posterior margin of compound eyes touching anterior margin of prothorax. Two lateral ocelli present, anterior or median ocellus lacking or not visible; lateral ocelli about twice as far apart as each is distant from adjacent compound eye.

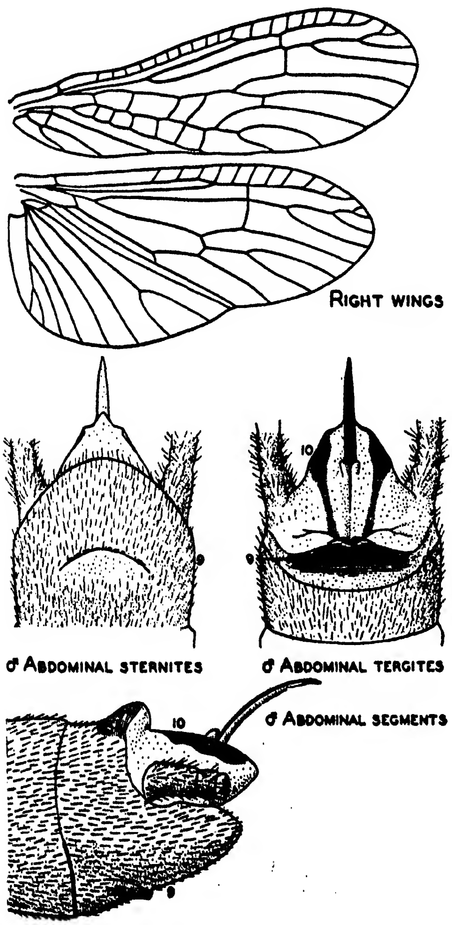


Fig. 6.—*Peltoperla zipha.*

Pronotum much wider than long, anterior corners angular and posterior corners much rounded, raised rugosities on posterior two-thirds of area. Legs with third tarsal segments much longer than second and first tarsal segments combined, the first segment slightly longer than the second.

Dorsum of abdomen without special structures through ninth tergite; tenth tergite with anterior part forming a strongly sclerotized upraised ridge attached to a cleft, more membranous area from which the long, slender, pointed supra-anal process arises, fig. 6; two minute membranous lobes are adjacent to place where supra-anal process projects; ninth abdominal sternite with a broad, slightly elevated, weakly developed lobe in middle. Cerci straight, with about 14 segments.

Wings extending far beyond tip of abdomen and with venation as illustrated in fig. 6.

The gill remnants are difficult to locate but there appear to be one on each side of the mesosternum and metasternum near point of articulation with leg and certainly one or more on each side near upper point of attachment of each mesothoracic and metathoracic leg. False gills are evident, one on each side, on the mesonotum and on the metanotum.

Length to tip of wings 12 mm.; length to tip of abdomen 8 mm.

Holotype, male.—Tributary of Little River, Elkmont, Tenn.: May 14, 1939, T. H. Frison & H. H. Ross.

This new species is quite different from any described species and is easily separated from *arcuata* Needham (Smith 1917) because it lacks the small lobe at base of the ninth abdominal sternite and has straight anal cerci. It differs markedly from the male of *cornelia* Needham & Smith and related forms in the shape of its supra-anal process.

TAENIOPTERYGIDAE

The generic classification of the Taeniopterygidae presents several problems which are impossible to elucidate thoroughly or unravel at this time. Studies of the North American species, adults and

nymphs have indicated that the species separate into two fundamentally different groups. These two groups were recognized in my studies of the Illinois species (1929, 1935*a*) as the genera *Taeniopteryx* Pictet (1841) (= *Nephelopteryx* Klapálek 1902) and *Strophopteryx* Frison (1929). Beginning with Klapálek, in 1902, numerous generic names have been proposed for the reception of various species in this family. Since the world species break up into many small units, and each new species seems to present a new combination of the characters used as the basis for these genera, I am following the course, at least for the present, of accepting these names as subgenera and holding to a generic division which presents more marked or fundamental differences in the nymphs as well as adults.

The name of *Taeniopteryx* Pictet (1841) with its genotype of *nebulosa* (Linnaeus), as used by me in 1929, still holds for one of these basic genera, and the name *Brachyptera* Newport (1851) with its genotype of *trifasciata* (Pictet) is the first name available for the other. *Strophopteryx* Frison (1929) belongs as one of the subgenera of *Brachyptera*. In *Taeniopteryx* belong the species like *maura* (Pictet), which have nymphs with coxal gills, adult males with one-segmented cerci and a ninth abdominal sternite reaching only to tip of abdomen, and adult females with the subgenital plate poorly developed. In *Brachyptera* belong the species like *fasciata* (Burmeister), which have nymphs lacking coxal gills, adult males with several-segmented cerci and a ninth abdominal sternite recurved up about the tip of the abdomen, and adult females with the subgenital plate much produced.

KEY TO GENERA OF TAENIOPTERYGIDAE

ADULTS

Males with one-segmented anal cerci, ninth abdominal sternite reaching only to tip of abdomen and not abruptly recurved upwards about tip of abdomen, forewings always normal; females with subgenital plate not or scarcely produced; both sexes show coxal gill scars........ **Taeniopteryx**

Males with several-segmented anal cerci, ninth abdominal sternite abruptly curved up about tip of the abdomen, forewings sometimes brachypterous; females with a well-developed and protruding subgenital plate; both sexes without traces of coxal gill scars....................... **Brachyptera**

NYMPHS

Coxal gills present and terminal abdominal structures suggestive of characters of adults....................... **Taeniopteryx**

Coxal gills absent and terminal abdominal structures suggestive of characters of adults....................... **Brachyptera**

Taeniopteryx maura (Pictet)

Nemoura maura Pictet (1841, p. 361). Original description, ♀.

Nemoura nivalis Fitch (1847, p. 274). New synonymy.

Taeniopteryx nivalis Frison (1929 and 1935*a*, pp. 378 and 341, respectively). Descriptions and records.

In my paper of 1929 I stated that "it is likely *nivalis* and *maura* are the same species," and, again, in 1935 that "there is a strong probability that *maura* (Pictet) and *nivalis* (Fitch) are the same species . . . in which case the former name would have priority."

Since these earlier papers I have had occasion to determine many hundreds of specimens from all parts of the distributional range of *nivalis* and *maura*, and I have come to the definite conclusion that *nivalis* should be regarded as a synonym of *maura*. In the past, *maura* and *nivalis* have been separable in the males only, and then on the basis of the presence or absence of a toothlike projection on the lower surface of each femur. As first pointed out in 1929, I find in the males from the same locality that some have this toothlike projection and others do not; in fact, specimens are not uncommon which have the tooth on one femur and lack it on the other. Another structural character of *maura* displaying great variation in size and shape is the lobe near the base of the ninth abdominal sternite. Coupled with the facts that two species of females cannot be detected and that differences in other characters known to be of great specific importance (such as the cerci, supra-anal process and subanal lobes) cannot be found, it no longer seems tenable to recognize *maura* and *nivalis* as two distinct species.

Whether the name of *maura* is being correctly used can never be definitely settled because, as Ricker (1938) records, only parts of the type remain, and they are not the parts most needed to make accurate determinations of species belonging to this family. No specimens of the typic

series of *nivalis* are known to be in existence. It seems that the best interests of nomenclature and taxonomy will be served by using the name of *maura* for this species.

It has been interesting to find, in a large series of specimens from Oregon, adult and nymphal specimens which I cannot satisfactorily separate from *maura* material taken in eastern North America (Frison 1942). Slight differences in wing color seem to exist, but characters of this nature are apt to be variable. *Taeniopteryx maura* is common in parts of Minnesota, and no doubt it will be found eventually in states or Canadian provinces east of Oregon and west of Minnesota.

The species *maura* (= *nivalis* and *maura*) has been previously recorded from the District of Columbia, Illinois, Maine, Maryland, Massachusetts, New Hampshire, New York, North Carolina, Nova Scotia, Pennsylvania and Virginia. To this list I can now add the states of Connecticut, Florida, Georgia, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, Oklahoma, Oregon, Tennessee, West Virginia and Wisconsin.

Taeniopteryx parvula Banks

Taeniopteryx parvula Banks (1918, p. 7). Original description, ♂.

Taeniopteryx parvula Frison (1929, p. 383, and 1935*a*, p. 345). Additional descriptions and records.

The typic series of *parvula* consists of two males, No. 10,049, in the collection of the Museum of Comparative Zoology. One of these is from "Washington, D. C.," and the other from "Peach Grove Hill, Va., Feb. 21, 1915," and I am selecting the latter as the **lectotype**.

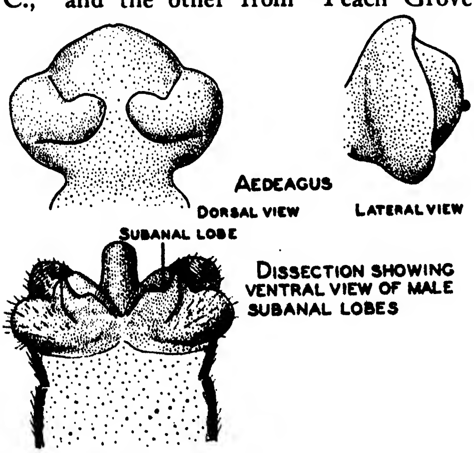


Fig. 7.—*Taeniopteryx parvula.*

In view of the fact that there is another species of *Taeniopteryx*, described in this article as *lita*, very closely related to and apt to be confused with *parvula*, I wish to present drawings of the aedeagus, fig. 7, and of the subanal lobes, not previously illustrated. Drawings of other aspects of *parvula* are available for comparison in Frison 1935*a* (figs. 190, 214 and 223). It has been an interesting discovery to find that the aedeagus of *parvula* and of *lita* are very different, a discovery suggesting that this character merits study in the case of other species of this family.

Taeniopteryx lita new species

MALE.—In general similar to *parvula* Banks as redescribed by Needham & Claassen (1925). It differs from *parvula* as follows: The supra-anal process is much broader at tip, and the one-segmented cerci have a small finger-like process on upper surface, fig. 8; subanal lobes are prominent and lobate at tips, whereas in *parvula* these same lobes are less developed and terminate in a small pointed hook, fig. 7; ninth abdominal sternite with a membranous area on posterior median margin covered and surrounded with long, fine setae, fig. 8; aedeagus in various views as in fig. 8.

Wing venation as in fig. 8. Length to tip of wings 10 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male. Genital opening near middle of eighth abdominal sternite, not covered by a plate, sclerotized areas bordering opening larger, fig. 8, than in *parvula* (Frison 1935*a*, fig. 214).

Holotype, male.—Elizabethtown, Ill.: March 7, 1928, T. H. Frison & H. H. Ross.

Allotype, female.—Same data as for holotype.

Paratypes. — ILLINOIS. — ELIZABETHTOWN: Same data as for holotype, 3♂. GOLCONDA: March 17, 1932, H. H. Ross, 1♂. GRAYVILLE, Wabash River: March 8, 1928, T. H. Frison & H. H. Ross, 7♂.

ARKANSAS.—BRASFIELD, Cache River: April 16, 1939, H. H. & J. A. Ross, 1♂.

INDIANA.—ST. ANTHONY: Feb. 13, 1938, T. H. Frison & C. O. Mohr, 1♂. ROGERS, White River: March 14, 1936, T. H. Frison & H. H. Ross, 4♂. WINSLOW, Patoka River: Feb. 14, 1938, T. H. Frison & C. O. Mohr, 2♂.

MARYLAND.—PRIESTS BRIDGE: Feb. 25, 1938, B. D. Burks, 1♂.

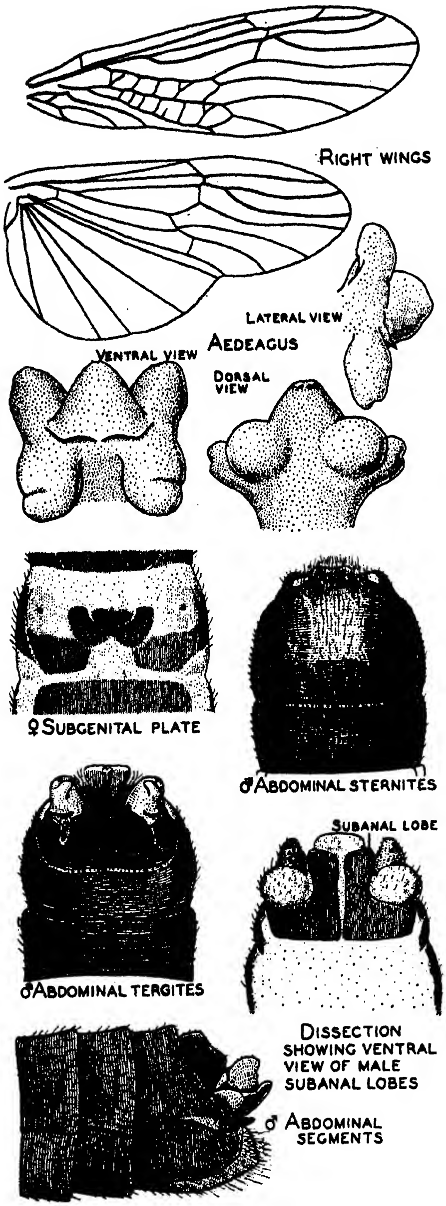


Fig. 8.—*Taeniopteryx lita.*

Mississippi.—Potts Camp: Feb. 17, 1941, T. H. Frison, 1♂, 2♀.

This is a species apparently with a more southern distribution than *parvula* and easily apt to be confused with it. It is not unlikely that some of the records of Needham & Claassen (1925) for *parvula* pertain to this new species. Illinois records of *parvula* from Elizabethtown (in part), Golconda and Grayville (in part) recorded in my 1929 and 1935*a* papers belong to this species.

Brachyptera fasciata (Burmeister)

Semblis fasciata Burmeister (1839, p. 875). Original description.

Strophopteryx fasciata Frison (1929 and 1935*a*, pp. 384 and 347, respectively). Additional descriptions.

In 1929 I proposed the generic name of *Strophopteryx* for the inclusion of *fasciata*, because *fasciata* possessed some characters which did not fit the various genera then in use for the Taeniopterygidae. Also, I wished to emphasize the marked fundamental differences existing in both adults and nymphs between such Illinois stoneflies as the species then known as *Taeniopteryx nivalis* (Fitch) and *Semblis fasciata.*

In my remarks in this article under the heading of Taeniopterygidae, I have stated my reasons for now recognizing but two genera in this family, *Taeniopteryx* and *Brachyptera.* This procedure reduces *Strophopteryx* to subgeneric status along with such names as *Rhabdiopteryx* Klapálek and *Oemopteryx* Klapálek.

While determining large series of *fasciata*, I have observed instances of variation. The most noticeable involves the occurrence or non-occurrence of membranous

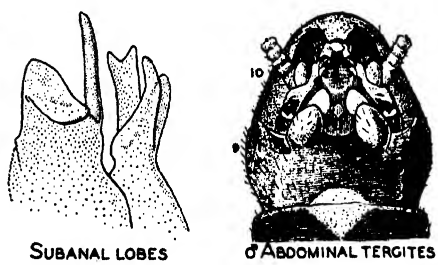


Fig. 9.—*Brachyptera fasciata.*

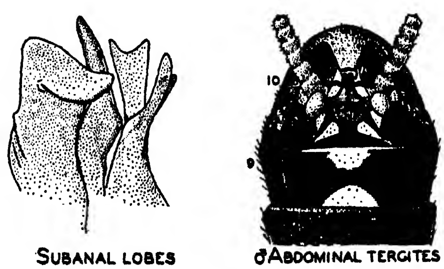


Fig. 10.—*Brachyptera fasciata.*

lobes, one on each side, on the posterior margin of the ninth abdominal tergite in the males, fig. 9; in some males these lobes are present, whereas in many specimens they are lacking or relatively undeveloped, fig. 10. The subanal lobes of this species are asymmetrical, and in spite of their complexity I have failed to find marked differences in kind between these structures in males with and in males without the lobes on the ninth abdominal tergites, figs. 9 and 10. This latter fact, plus failure to find differences in the females and nymphs, has influenced my evaluation of the absence or presence of these lobes on ninth abdominal tergite as a non-specific character.

Brachyptera glacialis (Newman)

Nemoura (Brachyptera) glacialis Newman (1851, p. 451). Original description, ♂, ♀.
Taeniopteryx (Oemopteryx) alex Hanson (1938, p. 79). New synonymy.
Taeniopteryx glacialis Ricker (1938, p. 131). Notes regarding types.

In the collection of the Museum of Comparative Zoology, there is a male of *glacialis* from "Hudson's Bay" which is undoubtedly the typic male specimen mentioned by Ricker (1938) as having "been sent to the Museum of Comparative Zoology." Ricker (1938) selected lectotypic and lecto-allotypic specimens from the series of two male and three female types now in the British Museum. This species was entirely omitted by Needham & Claassen (1925) in their *Monograph.*

I have studied in fluid the genitalic structures of the typic male in the Museum of Comparative Zoology, paratypic specimens of *Taeniopteryx (Oemopteryx) alex* and other specimens, and as a result I have come to the conclusion that *alex* is a synonym of *glacialis*. I can find no definite characters to separate them, and any differences observed can be ascribed to variation.

Hanson described *alex* from specimens collected at Wells, Hamilton County, N. Y. Records or specimens in the Illinois Natural History Survey collection or specimens I have determined for others are as follows.

CONNECTICUT.—DANIELSON: March 24, 1937, H. H. Ross, 5♂, 4♀.
MINNESOTA.—LAKE COUNTY, Stewart River: March 26, 1938, R. H. Daggy & W. S. Chalgren, 5♂.
UTAH.—MYTON: March 16–19, 1940, R.A.Z., 3♂, 5♀.

Brachyptera oregonensis (Needham & Claassen)

Taeniopteryx oregonensis Needham & Claassen (1925, p. 248). Original description, ♂.

This species was originally described from males only, collected at Corvallis, Ore. Since the female has not been previously described it seems desirable here to

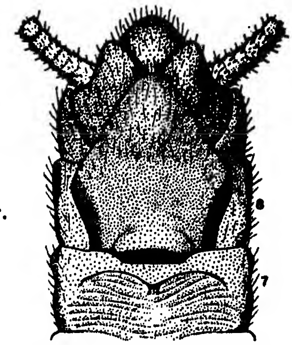


Fig. 11.—*Brachyptera oregonensis.*

illustrate the important features of the terminal abdominal sternites of a female, fig. 11, based upon a specimen collected at Dixon Creek, Corvallis, Ore., March 10, 1935, by R. E. Dimick. Since all other characters are approximately the same as those in the male, this illustration showing the shape of the subgenital plate will suffice for a description of this sex, and the specimen is designated at the **allotype.**

A large number of specimens of *oregonensis* are now in the Illinois Natural History Survey collection, and I have determined many specimens for others. These records are too numerous to be given in detail here but come from the following localities in Oregon: Benton County, Canyonville, Clackamas County, Clatskanie, Clatsop County, Columbia County, Corvallis, Crabtree, Forest Grove, Hillsboro, Lebanon, Lewisburg, Oak Creek, Philomath, Polk County, Portland, Salem, Seaside, Warren and Wren.

Brachyptera pacifica (Banks)

Taeniopteryx pacifica Banks (1900, p. 244). Original description, ♂, ♀.
Taeniopteryx raynoria Frison (1942, p. 9). Recent synonymy.
Taeniopteryx kincaidi Frison (1942, p. 9). Recent synonymy.

In a recent publication (1942), I treated *raynoria* Claassen (1937*b*) and *kincaidi* Hoppe (1938) as synonyms of *pacifica.* Additional comments regarding the types involved and the synonymy adopted are herewith presented.

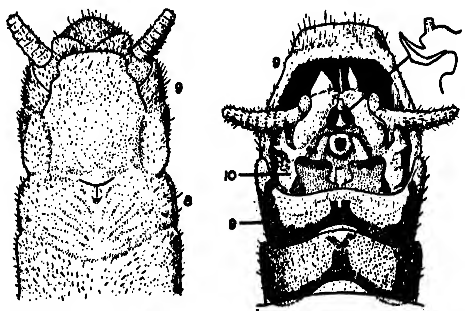
The types of *pacifica* are in the collection of the Museum of Comparative Zoology and bear the type number "11,304" and the locality of "Pullman, Washington." In the typic series are three specimens, one male and two females. Through the kindness of Dr. Nathan Banks I was permitted to relax and study closely in fluid the genitalic characteristics of one male, and I herewith designate this male specimen as the **lectotype**.

The holotype, allotype and paratypes of *kincaidi* were sent to me for study through the kindness of Professor Trevor Kincaid of the University of Washington, and the holotype and allotype of *raynoria* were studied through the courtesy of Professor J. Chester Bradley of Cornell University.

I synonymized *raynoria* and *kincaidi* with *pacifica* in my most recent stonefly paper (1942) because of my belief that all observable differences fall within the limits of specific variation and involve no marked differences in kind of structures. The differences observed included variation in the size and shape of the rearward-pointing appendages on the tenth abdominal tergite and the lobes protruding upward from the bases of the cerci, as well as differences in pigmentation of the abdominal segments. It may be that some of these differences predominate in certain geographical areas, and such names as *raynoria* and *kincaidi* can be used in the future for geographical races or subspecies. For instance, the rearward-pointing lobes on the tenth abdominal tergite of the type of *raynoria*, which comes from "Yosemite, California," is larger than in many specimens I consider as *pacifica* in the Illinois Natural History Survey collection from Oregon, Washington and British Columbia.

Claassen (1937*b*) gave an illustration of the lateral view of the terminal abdominal segments of his *raynoria*, and better to show its similarity with *pacifica* I include here a dorsal view of the terminal abdominal segments of the holotypic male, fig. 12, and a ventral view of the terminal abdominal segments of the allotypic female, fig. 12, which Claassen did not illustrate.

Taeniopteryx kincaidi, from several localities in Washington, was placed in the synonymy of *pacifica* (Frison 1942) for the same general reasons as just given in the case of *raynoria*. In her key involving the separation of the species of *Taeniopteryx* from Washington, Hoppe (1938) keys out *pacifica* from *kincaidi* on the basis of the presence of two raised rearward-pointing appendages on the tenth abdominal tergite of the male in *pacifica* and their lack in *kincaidi*. No good specific characters for the separation of these



♀ABDOMINAL STERNITES ♂ABDOMINAL TERGITES

Fig. 12.—*Brachyptera pacifica.*

two species are given in the original description of *kincaidi*. An examination of the males in the typic series of *kincaidi* reveals the presence of these lobes exactly as in *pacifica*. The statements in the key regarding "Hind margin of the tenth tergite extended rearward" undoubtedly refer to the ninth tergite, and this particular structure seems to vary considerably in specimens of *pacifica*.

Taeniopteryx pallida (Banks 1902), described from "Little Beaver, Colo., July 18, 1898," is yet another species which must be considered in the final synonymy of the *pacifica* complex. Although at the present time I cannot certainly separate the typic female of *pallida* from other females of the *pacifica* complex, I have hesitated to sink this name in synonymy because of lack of males associated with females which may be considered as *pallida*. There is a possibility that the male when found might be distinct enough to warrant specific recognition. On the other hand if the male that goes with *pallida* falls within the *pacifica* complex, then the name *pallida* will be antedated only by *pacifica*.

It has been most interesting to discover that *pacifica* is not restricted to the western states and that it occurs in cold rapid streams in the mountainous parts of Maryland, New Hampshire, New York, North Carolina, Tennessee, Virginia, and no

doubt other states. Critical comparative studies of eastern and western material have failed to reveal any significant characters for the separation of eastern specimens from western specimens. With respect to variation in the size of the lobes on the posterior margin of the tenth abdominal tergite, the eastern specimens are of the small type. A similar instance of a species of taeniopterygid occurring in both eastern and western parts of the United States has been recorded for *Taeniopteryx maura* (Pictet) under the name of *nivalis* (Fitch) by Frison (1942).

Records for *pacifica* from eastern North America, based upon material in the Illinois Natural History Survey collection or examined by me, are as follows.

MARYLAND.—PINEY GROVE: April 19, 1938, H. H. Ross, 1♂.

NEW HAMPSHIRE.—MOUNT WASHINGTON: Brook near Pinkham Notch Camp, June 22, 1941, Frison & Ross, 1♂, ♀♀.

NEW YORK.—MOUNT TREMPER, Esopus Creek: April 27, 1935, P. Jennings, 1♀. PHOENECIA: May 5, 1940, P. Jennings, 1♂, 3♀. SCHOHARIE: ex trout stomach, April, 1937, P. Jennings, 2 nymphs; May 5, 1937, P. Jennings, 1♂; May 28, 1937, Flock, 1♀; April 16, 1938, P. Jennings, 1♂, 2♀; ex trout stomach, April, 1940, P. Jennings, 1♂, 2♀, 2 nymphs.

NORTH CAROLINA.—BLOWING ROCK: March 23, 1940, Frison, Mohr & Hawkins, 1♀, 2 exuviae; near Grandfather Mountain, west of town, March 23, 1940, Frison, Mohr & Hawkins, 3 nymphs. WILLETS: March 23, 1940, Frison, Mohr & Hawkins, 1♂, 2♀.

TENNESSEE.—GATLINBURG: March 24, 1940, Frison, Mohr & Hawkins, 4♂, 5 exuviae. GREENBRIER COVE: March 15, 1938, 2,000 feet elevation, Smoky Mountains, A. C. Cole, 1♀.

VIRGINIA.—SPEEDWELL: March 22, 1940, Frison, Mohr & Hawkins, 1♀, 2 exuviae. SPERRYVILLE: March 17, 1940, Frison & Mohr, 2♀.

Brachyptera vanduzee (Claassen)

Taeniopteryx vanduzee Claassen (1937*b*, p. 46). Original description, ♂.

I have studied the type of this species in the collection of Cornell University, through the kindness of Professor J. Chester Bradley, and find *vanduzee* to be a distinct and valid species. It differs from all other western species of the genus in the presence of a lobe on the ninth abdominal sternite. The genitalic structures are complicated, and, since the illustration given by Claassen (1937) is rather indistinct, I present fig. 13 of the type showing in greater detail important features of this species.

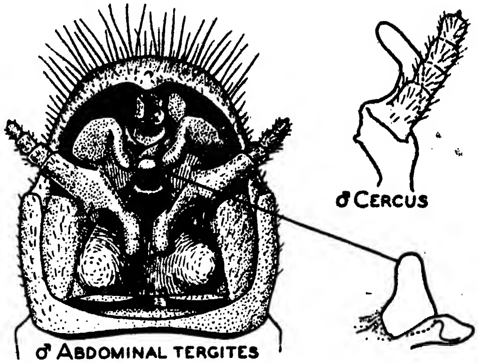
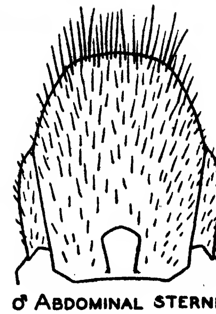


Fig. 13.—*Brachyptera vanduzee.*



The type was collected at "Tahoe, California." Additional specimens of this species have not been seen or recorded by other entomologists.

Brachyptera contorta
(Needham & Claassen)

Taeniopteryx contorta Needham & Claassen (1925, p. 242). Original description, ♂.

This species has not been recorded in literature since it was described from a single male from "Jaffery, N. H., March 18, C. W. Johnson" in the collection of Cornell University. Since the female and nymph have not been described, I present brief descriptions of their most important characters as follows.

FEMALE.—In general similar to the male as described by Needham & Claassen (1925). Coxae without small, round, membranous areas on ventral surfaces (evidence of lack of tracheal coxal gills in nymph). Venation of wings as in fig. 14. Ninth abdominal sternite produced into broad, rounded plate shaped as in fig. 14.

Allotype, female.—East Hampton, Lyman's Brook, Conn.: March 24, 1937, H. H. Ross. Taken at same time and place as males of the same species.

NYMPH.—In general similar to the nymph of *fasciata* (Burmeister), as described by Frison (1929, p. 385). Differs

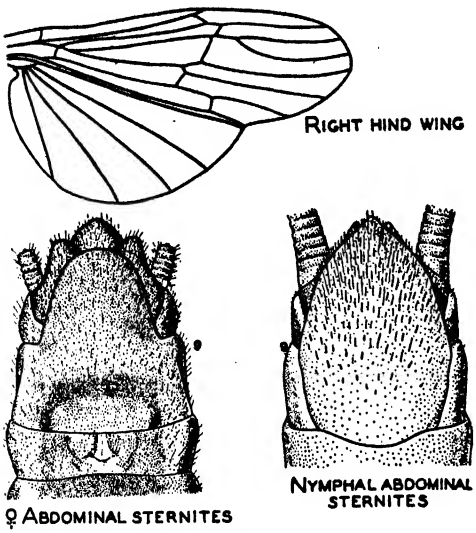


Fig. 14.—*Brachyptera contorta.*

chiefly in that ninth abdominal sternite has a broad, platelike projection extending about to tip of abdomen, fig. 14, instead of a narrow, platelike projection.

Nymphal specimens from same locality as allotype.

Illinois Natural History Survey collection records are as follows.

CONNECTICUT.—EAST HAMPTON: Same data as for allotype, 2♂, 1♀, 16 nymphs.

VIRGINIA.—STANDARDSVILLE: March 21, 1940, T. H. Frison, C. O. Mohr & A. S. Hawkins, 1♂, 7♀. SPERRYVILLE: March 17, 1940, T. H. Frison, *et al.*, 7♂, 3♀, 3 nymphs.

Brachyptera rossi new species

MALE.—General habitus similar to that of other species of *Brachyptera*. Head, thorax and abdomen mostly black with portions suffused with reddish brown. Antennae black, the segments longer than broad throughout length. Legs with tarsi, tibiae and apical third of each of the femora black; basal two-thirds of each of the femora yellowish brown. No traces of membranous gill scars on coxae. Wings with veins black and membrane smoky, venation as in fig. 15.

Apical abdominal segments intricately modified and presenting the distinctive characters, fig. 15, for this new species as follows: Ninth abdominal sternite greatly prolonged into a plate which extends back beyond the tip of abdomen, then bends upwards and is club headed at tip as viewed from the side, with a stout, sickle-shaped structure at tip as viewed from above, and near its base there is a prominent lobe; tenth abdominal tergite bears two slender, pointed projections, directed backwards, on middle of posterior margin; cercus 5 or 6 segmented, with a platelike lobe at its base above; supra-anal process a short, stout, pointed lobe; subanal lobes complicated, asymmetrical and, viewed from above, as in fig. 15. Length to tip of wings, 13 mm.

Holotype, male. — Near Woodstock, Bog Brook, N. H.: June 21, 1941, T. H. Frison & H. H. Ross.

I take great pleasure in naming this species for Dr. H. H. Ross, of the Illinois Natural History Survey staff, who has greatly assisted in many ways my studies of the North American Plecoptera.

Five *Brachyptera* exuviae were found under a bridge near the place where the

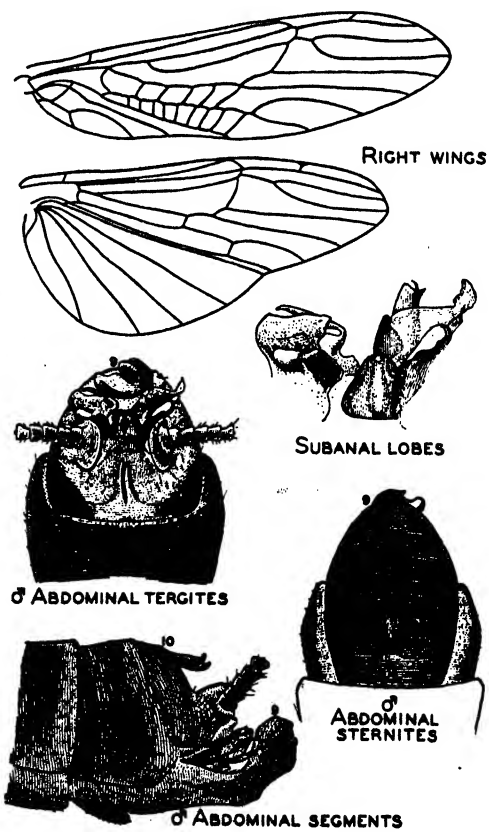


Fig. 15.—*Brachyptera rossi.*

holotype was collected. The exuviae represent both males and females, are very dark, lack a longitudinal pale stripe on abdominal tergites, lack coxal gills and, from shape of apical abdominal segments, undoubtedly should be associated with *rossi*.

The peculiar, pointed projections on the tenth abdominal tergite, combined with the lobe on the ninth abdominal sternite, readily separate the adult of this new species from adults of all previously described species.

Brachyptera limata new species

MALE.—General habitus similar to that of other species of *Brachyptera*. Head, thorax and abdomen mostly yellowish

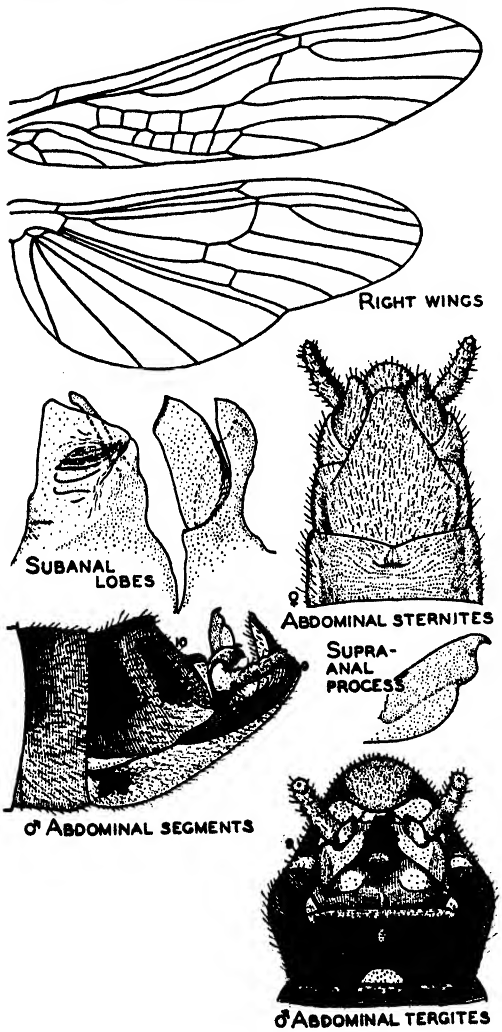


Fig. 16.—*Brachyptera limata.*

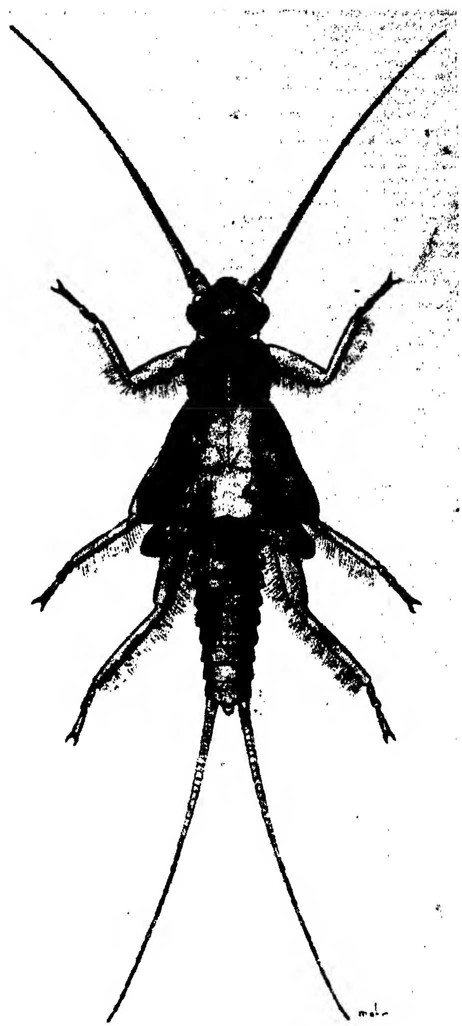


Fig. 17.—Nymph of *Brachyptera limata.*

brown, antennae and parts of thorax dark brown. No traces of membranous gill scars on coxae. Wings stained with brown, venation as in fig. 16.

Apical abdominal segments intricately modified and presenting the most distinctive characters for this new species, fig. 16, as follows: Ninth abdominal sternite greatly prolonged into a plate which extends back beyond tip of abdomen, then bends upward, but becomes considerably narrowed at tip, without a lobe near base; tenth abdominal tergite without any projections near base; cerci several segmented, with a small globose lobe above base; supra-anal process short, somewhat re-

curved up and forward with tip forming a point; subanal lobes complicated, asymmetrical and, as viewed from above, are as in fig. 16.

Length to tip of wings 10 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male. Genital opening near middle of eighth abdominal sternite not covered by a plate. Ninth abdominal sternite prolonged to form plate reaching nearly to tip of abdomen and rounded at tip, fig. 16.

Holotype, male.—Newfound Gap near Gatlinburg, Little Pigeon River, Tenn.: May 14, 1939, T. H. Frison & H. H. Ross.

Allotype, female.—Same data as for holotype.

Paratypes.—TENNESSEE.—NEWFOUND GAP: Same data as for holotype, 22♂, 78♀.

NYMPH.—In general similar to the nymph of *fasciata* (Burmeister), as described by Frison (1929, p. 385). No longitudinal pale stripe on abdominal tergites, fig. 17. Platelike projection of ninth abdominal sternite somewhat broader than in *fasciata*, and abdominal tergites uniformly brownish.

Nymphal and exuvial specimens with same data as for holotype.

This new species presents many structures which place it close to the western *Brachyptera nigripennis* (Banks), from which it differs, however, in shape of supra-anal process, in shape of lobes at base of each cercus, and by the much-narrowed tip of the ninth abdominal sternite. It differs from *B. pacifica* (Banks), another western species, in lacking lobes at base of tenth abdominal tergite, by the much-narrowed tip of ninth abdominal sternite, and other characters.

LEUCTRIDAE

Leuctra Stephens

At the time of the publication of *The Stoneflies, or Plecoptera, of Illinois* (Frison 1935*a*), *claasseni* Frison (1929) was the only species of *Leuctra* known to occur in Illinois. Since then, intensive field work in exceedingly local, small and segregated habitats has revealed the presence of two additional species. It becomes desirable, therefore, to record these new additions to the Illinois list, to illustrate the characters most useful in recognizing the three Illinois species and to present a key for identifying them.

KEY TO ILLINOIS SPECIES OF *LEUCTRA* ADULTS

MALES

1. Ninth abdominal tergite with a prominent, sharply outlined, deep, longitudinal cleft, fig. 18 .... **claasseni**
   Ninth abdominal tergite without such a cleft 2
2. Seventh abdominal tergite with a conspicuous, rearward-pointing process, fig. 20 .... **tenuis**
   Seventh abdominal tergite without a special process, fig. 19 .... **decepta**

FEMALES

1. Eighth abdominal sternite about as long as seventh, with posterior margin in middle indented so that sternite is bilobed 2
   Eighth abdominal sternite much shorter than seventh, posterior margin not bilobed; three small, separated, humplike areas on anterior margin, fig. 18 .... **claasseni**
2. Seventh and eighth abdominal sternites conspicuously fused; cleft between lobes of posterior margin of eighth sternite wide and deep, sides and tips of lobes formed by a cleft more strongly and darkly sclerotized than rest of sternite, fig. 20 .... **tenuis**
   Seventh and eighth abdominal sternites indistinctly or weakly fused; cleft between lobes of posterior margin of eighth sternite narrow, sternite almost uniformly sclerotized, fig. 19 ..... **decepta**

Hanson (1941) in a recent paper has separated *Leuctra* as previously used by other North American workers into two genera, *Leuctra* Stephens and *Paraleuctra* Hanson. It is obvious to anyone who has closely studied a series of species of *Leuctra* (*s.l.*) that this genus contains some smaller complexes. *Paraleuctra* may be of generic rank, but, for the time being, pending a thorough revisional study of the Leuctridae, I prefer to recognize *Paraleuctra* as a subgenus. If *Paraleuctra* is a valid genus, it is probable that other additional generic names will be necessary. *Paraleuctra* is represented in Illinois by *claasseni* Frison.

Leuctra claasseni Frison

Leuctra claasseni Frison (1929, p. 404). Original description, ♂.

Leuctra claasseni Frison (1935*a*, p. 355). Description and new records, ♀.

The original description of this species was based solely upon Illinois specimens,

and additional records of specimens from Missouri and Oklahoma were added in 1935. Since the Missouri record was based upon a nymph whose identity was assumed because of the presence of *claasseni* in similar and adjacent territory in Illinois, a doubtful procedure in this genus where nymphs are of homogeneous appearance, I am pleased to confirm the Missouri record from adult specimens and to add additional distributional records as follows.

INDIANA.—TURKEY RUN STATE PARK, Newby Gulch: May 12, 1933, T. H. Frison & C. O. Mohr, 1 nymph. Tributary of Sugar Creek, east of TURKEY RUN STATE PARK: April 9, 1940, T. H. Frison & H. H. Ross, 11♂, 5♀, 1 nymph.

MISSOURI.—Southeast of ELLSINORE: March 8, 1939, T. H. Frison & C. O. Mohr, 1♂ (reared), 1♀, 2 nymphs.

OHIO.—ASH CAVE: March 6, 1938, T. H. Frison, 1♂.

New illustrations of the important male and female structures, fig. 18, are presented to aid with the separation from other Illinois species. Both the male and the female of this species are markedly different from *decepta* Claassen and *tenuis* (Pictet), the other two Illinois species of

Fig. 18.—*Leuctra claasseni*

Leuctra; in fact, *claasseni* is so distinctive that it represents a subgroup or division among North American species of the genus, which Hanson (1941) has named *Paraleuctra*.

Leuctra decepta Claassen

Leuctra decepta Claassen (1923, p. 260). Original description, ♂, ♀.

Leuctra decepta Needham & Claassen (1925, p. 227). Additional record.

Leuctra decepta Claassen (1931, p. 99). Nymphal description.

Leuctra decepta was described from New York specimens and, since the original description was published, this species

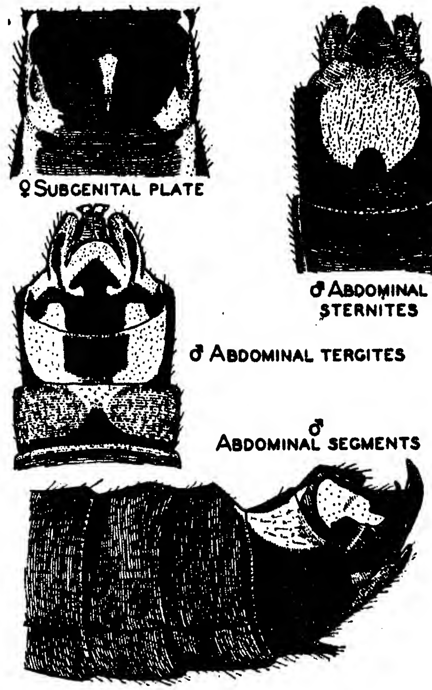


Fig. 19.—*Leuctra decepta*.

has not been recorded from other states. The recent finding of this species in southern Illinois and other places indicates it is widely distributed in eastern North America.

Since this species was not known to occur in Illinois when my report on the Illinois stonefly fauna was published in 1935, I am presenting illustrations, fig. 19, to aid with its recognition. The structural features of both male and female show *decepta* to be much more closely re-

lated to *tenuis* (Pictet) than to *claasseni* Frison.

New locality records are as follows.

ILLINOIS.—HEROD, spring tributary to Gibbons Creek: May 24, 1940, C. O. Mohr & B. D. Burks, 3♂ (2 reared), 3♀, 7 nymphs; May 29, 1939, B. D. Burks & G. T. Riegel, 2♂, 1 nymph; May 30, 1940, B. D. Burks, 4 nymphs. EDDYVILLE, Lusk Creek: May 24, 1940, C. O. Mohr & B. D. Burks, 2♂, 2♀, 5 nymphs; June 1, 1940, B. D. Burks, 1♂, 2♀, 1 nymph.

FLORIDA.—Leon County, 12 miles west of TALLAHASSEE: Nov. 30, 1939, L. Berner, 2♂.

GEORGIA.—RABUN COUNTY, small creek flowing into Lake Burton: June 22, 1940, H. H. Hubbs, 1♂.

MAINE.—NEW LIMERICK, Hunter Brook: Aug. 25, 1937, T. H. Frison & T. H. Frison, Jr., 2♂.

MINNESOTA. — LAKE COUNTY, Encampment River: Aug. 5, 1939, B. T. Peters & R. H. Daggy, 5♂; July 4, 1938, H. Knutson, 1♂.

NEW BRUNSWICK. — ANAGANCE: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 1♂.

NEW YORK.—COLD BROOK: June 22 and 30, 1940, H. Dietrich, ♂♂, ♀♀. CAROLINE, Wild Flower Reserve: Aug. 16, 1928, T. H. Frison, 4♂.

NORTH CAROLINA.—NEWFOUND GAP: June 13, 1935, H. H. Ross, 2♂.

NOVA SCOTIA.—MOSER RIVER, Goldmine Brook cascades: July 19, 1939, J. A. C. Nicol, 8♂. SPRINGHILL JUNCTION: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 3♂. MOOSE RIVER: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 1♂. INGRAMPORT: Aug. 22, 1939, T. H. Frison & T. H. Frison, Jr., 1♂.

ONTARIO.—ALGONQUIN PARK, Costello Lake: various dates, June, July, August and September, 1938 and 1939, W. M. Sprules, ♂♂, ♀♀.

TENNESSEE. — GATLINBURG: June 13, 1940, T. H. Frison *et al.*, 5♂; Sept. 4, 1940, B. D. Burks, 4♂, 9♀.

VIRGINIA.—MOUNTAIN LAKE, Hunters Branch, 3,500 feet elevation: July 28, 1941, A. C. Cole, 1♂, 2♀.

Several nymphal specimens show anal gills as first illustrated for *claasseni* (Frison 1935*a*). Since *tenuis* (Pictet) nymphs also show these anal gills, all three of the Illinois species of *Leuctra* possess them. These anal gills are so delicate, however, that they are easily lost by the nymphs or overlooked in specimens.

Leuctra tenuis (Pictet)

Nemoura tenuis Pictet (1841, p. 375). Original description.

As in the case of *decepta* Claassen, the finding of *tenuis* in a segregated relic habitat in Illinois adds another species to the Illinois stonefly faunal list. Its finding is additional evidence that each locality, stream and other habitat, no matter how restricted, must be searched repeatedly at various seasons of the year if state faunal lists of stoneflies are to approach completeness. Diagnostic structures of the adult insects of *tenuis* are illustrated in fig. 20.

The type of *tenuis* came from Pennsylvania, and Needham & Claassen (1925) have added the additional state record of New York. The geographical range of this species will undoubtedly be greatly expanded with future collecting, as the following new records for its occurrence indicate.

ILLINOIS.—ELGIN, Botanical Gardens: Sept. 19, 1939, H. H. Ross & C. O. Mohr, 9♂, 4♀.

MAINE.—NEW LIMERICK, Hunter Brook: Aug. 25, 1939, T. H. Frison & T. H. Frison, Jr., 3♂.

MICHIGAN.—OTSEGO COUNTY, west branch Sturgeon River: June 24, 1936, J. W. Leonard, 2♂, 2♀; July 9, 1937, F. E. Lyman, 1♂, 1♀.

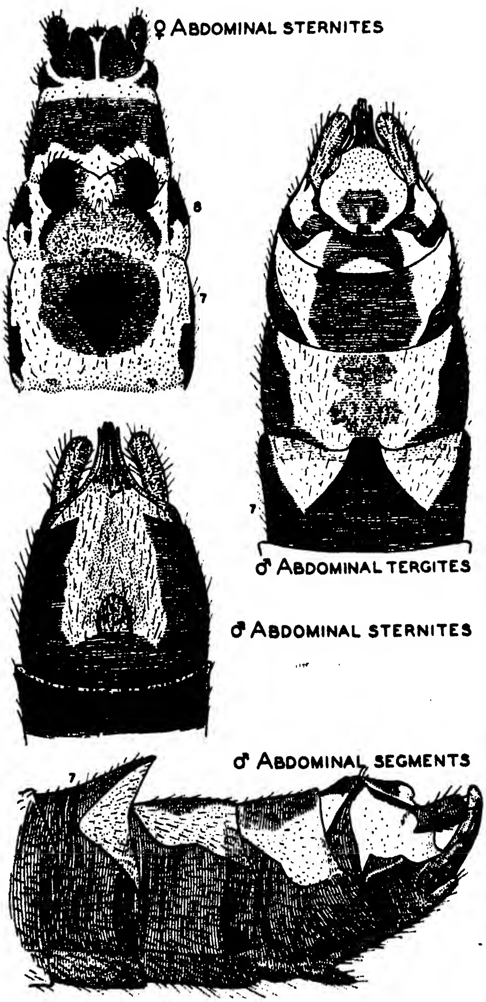


Fig. 20.—*Leuctra tenuis.*

CHEBOYGAN COUNTY, west branch Sturgeon River: July 3, 1938, J. W. Leonard, 2♂, 2♀. MONTMORENCY COUNTY, Hunt Creek: Aug. 30–Sept. 3, 1940, J. W. Leonard, 3♂, 1♀.

MISSOURI.—GREER SPRING: June 7, 1937, H. H. Ross, 2♂, 2♀.

NEW BRUNSWICK. — PETICODIAC: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 10♂. ANAGANCE: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 2♂, 5♀.

NEW YORK.—CAROLINE, Wild Flower Reserve: Aug. 16, 1928, T. H. Frison, 1♂. STRATFORD, Trammel Creek: July 19, 1934, H. K. Townes, 1♂, 2♀.

NOVA SCOTIA. — MOSER RIVER, Goldmine Brook: July 29, 1939, J. A. C. Nicol, 2♂, 2♀. CHESTER BASIN: Aug. 23, 1939, T. H. Frison & T. H. Frison, Jr., 4♂, 7♀, 5 nymphs. INGRAMPORT: Aug. 22, 1939, T. H. Frison & T. H. Frison, Jr., 1♀.

ONTARIO.—ALGONQUIN PARK, Costello Lake: June and July, 1938, and June, July and August, 1939, W. M. Sprules, ♂♂, ♀♀.

TENNESSEE. — CHIMNEYS CAMP GROUNDS, Great Smoky Mountains National Park: July 21, 1939, A. C. Cole, 1♂.

Several nymphs show remnants of anal gills as first recorded for *claasseni* (Frison 1935*a*) and also as noted for nymphs of *decepta* Claassen in this paper. Evidently such anal gills are to be expected in many if not all nymphs of *Leuctra.* They are very easily overlooked because of their delicate nature and are probably usually lost in handling.

Leuctra occidentalis Banks (1907)
Leuctra purcellana Neave (1934)
Leuctra forcipata Frison (1937)
Leuctra sara Claassen (1937*b*)

The study of a large series of specimens of any stonefly species is almost certain to show that slight variations of some structures in most species, and more in others, are to be expected. The genus *Leuctra* presents a group of species with very conspicuous morphological differences in most of the males named to date and less distinctive differences in the females.

One of the first described and a common western species of this genus is *occidentalis* Banks (1907). The male of this species is one of several having the anal cerci strongly sclerotized and peculiarly shaped. A taxonomic problem arises in determining which departures in shape of this structure from the typic *occidentalis* should be considered, at least for the time being, as species and which as simply variants. Fig. 21*A*, *B* and *C* shows the character of this structure in specimens from three different states, Oregon, Montana and California, respectively. A study of series of specimens indicates that the observable differences in these specimens is of the variant order.

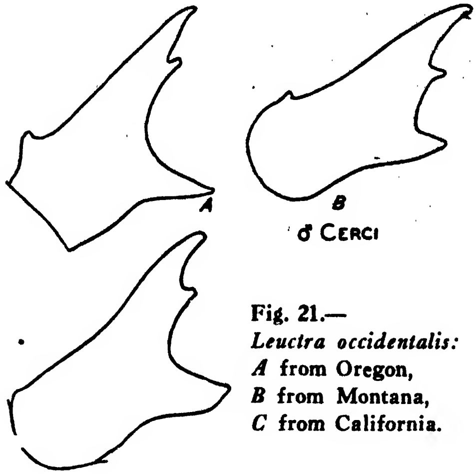


Fig. 21.—
Leuctra occidentalis:
A from Oregon,
B from Montana,
C from California.

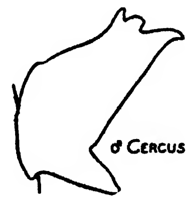


Fig. 22.—*Leuctra purcellana* from Prairie Hills, British Columbia.

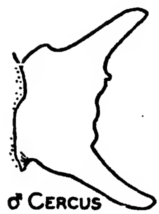


Fig. 23.—
Leuctra forcipata
from Oregon.

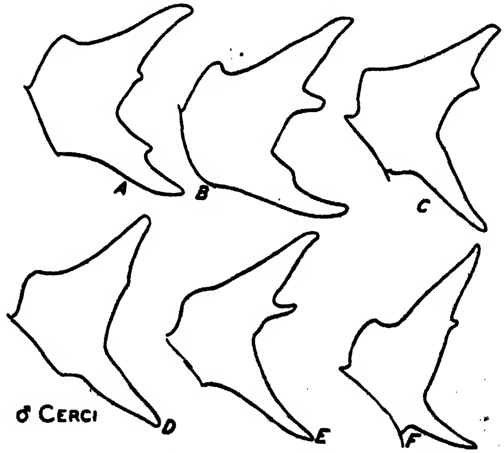


Fig. 24.—*Leuctra sara: A* from Massachusetts, *B* from Indiana, *C–F* from Tennessee.

Since *occidentalis* was described, three additional specific names of closely related forms have been proposed. Fig. 22 shows the modified anal cercus of a male specimen from "Prairie Hills, B. C., July 19, 1908," in the collection of the American Entomological Society of Philadelphia, which agrees very well with *purcellana* Neave (1934) described from British Columbia. Fig. 23 shows the modified anal cercus as it exists in specimens from Oregon that I described (1937) under the name of *forcipata*.

Claassen (1937*b*) proposed the name of *sara* for a species of this genus from New York which very closely resembles the western *occidentalis* and the related *forcipata* and *purcellana*. Fig. 24*A* shows the character of the variation observed in the modified anal cercus from a Massachusetts specimen; fig. 24*B* from an Indiana specimen; 24*C–F* from Tennessee specimens. I am strongly of the opinion that all of these eastern specimens are of the same species, and the differences are due merely to variations in local populations.

The differences between *sara* and *occidentalis* are certainly slight, and there is reason to suspect that collecting in northern states and southern Canada will show that *sara* is specifically the same as *occidentalis*. The same fate in synonymy may be in store for the more divergent forms described as *forcipata* and *purcellana*. Until further evidence to this effect is produced, however, it seems the safest procedure to hold *occidentalis*, *forcipata*, *purcellana* and *sara* as distinct species, recognizing that certain specimens are merely variants (no names necessary) of these more widely separated units. The recognition, for the time being at least, of these four major types as species causes me to propose another specific name for an even more divergent form. Certainly, this new form deserves specific status if *sara* (eastern states) is held as distinct from *occidentalis* (western states), because it is quite different from the other related forms.

Leuctra projecta new species

MALE.—Similar in most morphological features to *occidentalis* Banks (1907). Differs in the shape of the modified anal cercus as illustrated in fig. 25.

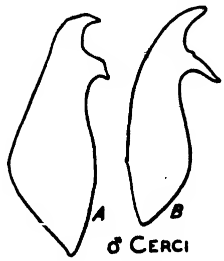
FEMALE.—Unknown but probably very similar to the female of *occidentalis*.

Holotype, male.—Rocky Mountain National Park, Wild Basin, Colo.: June 13, 1937.

Paratype. — OREGON. — COLUMBIA COUNTY, Scappoose Creek: Feb. 19, 1939, S. G. Jewett, Jr., 1♂.

The modified anal cerci of the paratype, fig. 25*B*, differ from those of the holotype, fig. 25*A*, as shown by comparing the two drawings. I am considering the two specimens, however, to be of the same species because of the features in common which are very different from those of the other described species. *Leuctra projecta* will fall in the group of species for which Hanson (1941) proposed the generic name of *Paraleuctra* and which, at least for the present, I am considering as of subgeneric status.

Fig. 25.—*Leuctra projecta.*



NEMOURIDAE

Nemoura Latreille

As in the case of the genus *Leuctra*, only one species of *Nemoura* was known to occur in Illinois when my paper (1935*a*) on the Illinois stonefly fauna was published. Recently, a second species of this genus has been found in northeastern Illinois, thereby necessitating the following keys for the separation of the Illinois species of *Nemoura*.

KEY TO ILLINOIS SPECIES OF *NEMOURA*

MALES

Gill remnants in cervical region; forward recurved part of supra-anal process narrow and elongate; anal cerci small, membranous and without special structures, fig. 26 .... **venosa**

Without gill remnants in cervical region; supra-anal process broad, somewhat knob-like, fig. 27; anal cerci elongate, strongly sclerotized and with projecting points at tip .... **trispinosa**, p. 261

FEMALES

Gill remnants in cervical region; eighth abdominal sternite forming a shelflike plate that is distinctly indented in middle and that protrudes from under the backward projecting posterior margin of seventh sternite, fig. 26 .... **venosa**

Without gill remnants in cervical region; eighth abdominal sternite not with small lobes on posterior margin showing under backward protruding posterior margin of seventh sternite, fig. 27 .... **trispinosa**, p. 261

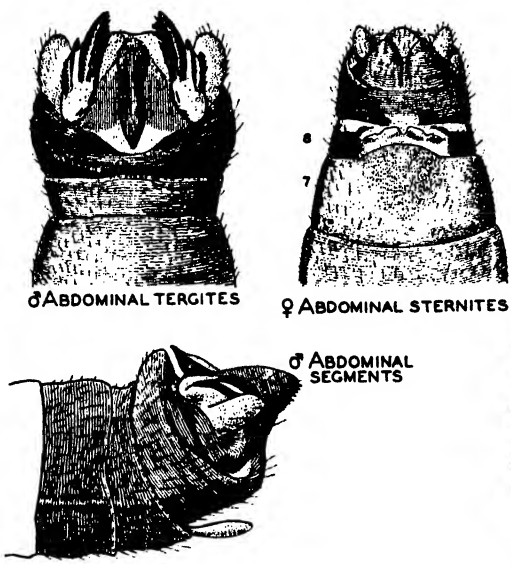


Fig. 26.—*Nemoura venosa.*

NYMPHS

Gills in cervical region (Frison 1935*a*, fig. 264) .... **venosa**

Without gills in cervical region, fig. 27 .... **trispinosa**, p. 261

Nemoura trispinosa Claassen

Nemoura trispinosa Claassen (1923, p. 289). Original description, ♂, ♀.

This species was originally described from New York specimens and subsequently recorded by Needham & Claassen (1925) from Quebec.

The finding of this species in a small, isolated relic habitat in northern Illinois, the same locality which produced the interesting record for *Leuctra tenuis* (Pictet), adds a second species of *Nemoura* to the Illinois list. It is desirable, therefore, to present an illustration, fig. 27, of the important characters used for identifying the sexes.

New records for this species are as follows.

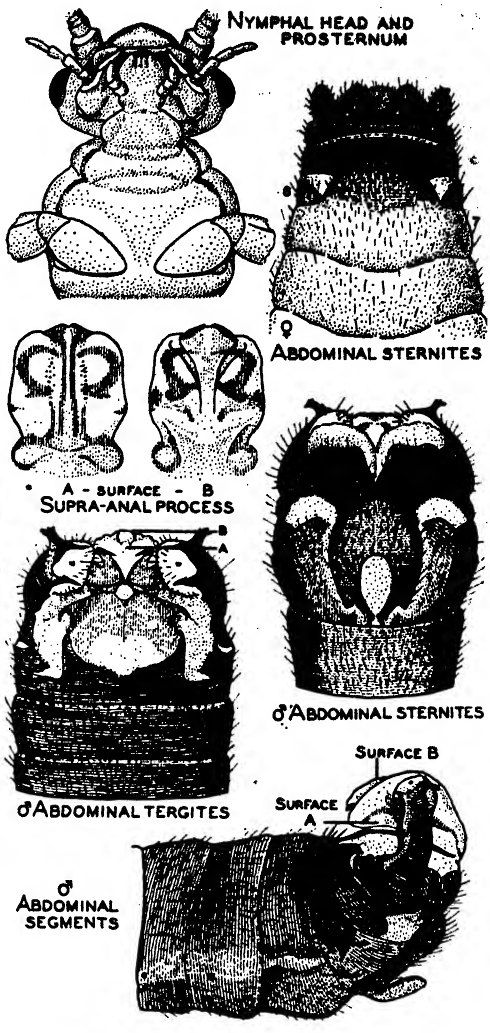


Fig. 27.—*Nemoura trispinosa.*

ILLINOIS.—ELGIN, Botanical Gardens: June 13, 1939, T. H. Frison & H. H. Ross, 4♂, 10♀, 13 nymphs; May 9, 1939, H. H. Ross & B. D. Burks, 17 nymphs.

NEW YORK.—ESSEX COUNTY, Artists Brook: June 23, 1940, H. Dietrich, 1♂.

Nemoura californica Claassen

Nemoura californica Claassen (1923, p. 284). Original description, ♂, ♀.

Nemoura lobata Frison (1936, p. 260). Original description, ♂. New synonymy.

When *lobata* was described by me in 1936, I mentioned that it was "very suggestive of *N. californica* Claassen." Since then I have seen additional western material and during a recent visit to the California Academy of Sciences had the

opportunity, through the courtesy of Dr. E. S. Ross, to study the holotypic male in the collection there. It is now my opinion that *lobata* is specifically identical with *californica* and therefore should be relegated to synonymy. Allowance must be made for slight variations in complicated genitalic structures of the character represented by this and other stonefly species.

The allotypic female as well as male and female paratypic specimens of *californica* are in the collection of Cornell University, and material in the Illinois Natural History Survey collection has been compared with these specimens.

CAPNIIDAE

In my 1935*a* paper on Illinois stoneflies, I presented a key for the separation of the genera of Capniidae occurring in Illinois. This key included the genera *Allocapnia* and *Capnia.* Under the discussion of *Nemocapnia carolina* Banks in the present paper, I show that my questionable record of a single Illinois specimen of *Capnia* (*vernalis* Newport?), a female (1929 and 1935*a*), belongs to the genus *Nemocapnia* and not to *Capnia.* However, in 1940, specimens of *Capnia opis* (Newman) were taken in northeastern Illinois, and it is desirable, therefore, to present a new key to the Illinois genera of Capniidae to replace the one of 1935*a.*

KEY TO ILLINOIS SPECIES OF CAPNIIDAE

ADULTS

1. Eighth abdominal tergite of male with a raised process or tubercle-like structure; wings sometimes absent or abbreviated; anal field or lobe of hindwing, when wing is present, large and extending nearly out to tip of wing .... **Allocapnia**, p. 265

   Eighth abdominal tergite of male without a raised process or tubercle-like structure 2

2. Wings normally developed; radial vein near point of origin with radial sector straight; no oblique crossvein beyond end of subcosta in forewing; posterior margin of large, darkly sclerotized medial area (mesobasisternite) of mesosternum but slightly produced backward, fig. 28 .... **Nemocapnia**, p. 262

   Wings normally developed, absent or abbreviated; radial vein near point of origin with radial sector slightly but distinctly bent forward; usually an oblique crossvein beyond end of subcosta in forewing; posterior margin of large, darkly sclerotized medial area (mesobasisternite) of mesosternum strongly produced backward, fig. 28 .... **Capnia**, p. 264

NYMPHS

(Nymphs homogeneous with respect to good key characters; mature nymphs frequently reveal characters used in adult key.)

Wing pads present in most species, but absent or rudimentary in a few species; anal field or lobe of hindwing, when pad is present, large and extending out nearly to length of wing; mesobasisternite of mesosternum, when boundary limits are visible, same as for adults, fig. 28 .... **Allocapnia**, p. 265

Wing pads always present; anal field or lobe of hindwing reduced and extending about to middle of wing length; mesobasisternite of mesosternum, when boundary limits are visible, same as for adults, fig. 28 .... **Nemocapnia**, p. 262

Wing pads present, absent or rudimentary; anal field or lobe of hindwing, when pad is present, reduced and extending about to middle of wing length; mesobasisternite of mesosternum, when boundary limits are visible, same as for adults, fig. 28 .... **Capnia**, p. 264

Nemocapnia carolina Banks

Nemocapnia carolina Banks (1938, p. 74). Original description, ♂, ♀.

Capnia sp. Frison (1929, p. 407). Erroneous generic assignment.

Capnia (*vernalis* Newport?) Frison (1935*a*, p. 356). Erroneous generic assignment.

In my paper on the *Fall and Winter Stoneflies, or Plecoptera, of Illinois* (1929), I questionably recorded a female specimen of a capniid from Grayville, Ill., March 8, 1928 (collected by T. H. Frison & H. H. Ross) as "*Capnia* sp." and in commenting concerning this specimen sug-

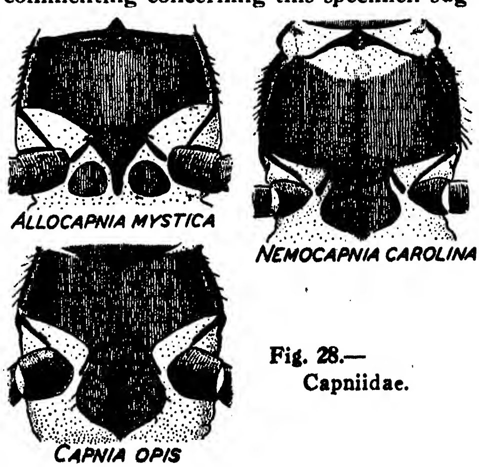


Fig. 28.—Capniidae.

gested it might be the female of *Capnia vernalis* Newport. Additional material of this species was not in hand in 1935 and so in my later and more comprehensive report of the Illinois stoneflies (1935*a*) I again cited this Illinois record and its questionable assignment to *vernalis*.

On the basis of several old specimens from "Morgantown, N. Car. (Morrison)" in the collection of the Museum of Comparative Zoology, Banks (1938) described a new genus, *Nemocapnia*, including in it a single species described as new under the name *carolina*. After seeing the typic specimens in 1939, I realized that the female Illinois specimen questionably recorded as *Capnia vernalis* in my papers of 1929 and 1935*a* was *N. carolina* Banks and not the female of a species of *Capnia*. Both males and females are easily recognized because of the characters of the wings. Although no seasonal data are associated with the typic specimens, the date of capture of the Grayville, Ill., specimen on March 8, 1928, and collection of other specimens in other states, places this species in the winter faunal list.

To facilitate recognition of this species, I present figs. 28, 29 and 30, which illustrate the important structural characters of the adult males and females, as well as the nymphal mouthparts. The dorsal view of a nymph is shown in fig. 31. Fig. 29 represents a specimen from North Carolina; fig. 30 represents specimens from Illinois and Indiana. The structure of the nymph confirms its placement in the Capniidae.

In addition to assigning correctly now the Grayville, Ill., March 8, 1928, female specimen to the species *Nemocapnia carolina*, thereby adding another genus and species to the Illinois list, I wish to add the following new records for the distribution of this recently described species.

ARKANSAS.—BENTON, Salt Creek: April 15, 1939, H. H. & J. A. Ross, 1♂.

INDIANA.—ROGERS, White River: April 17,

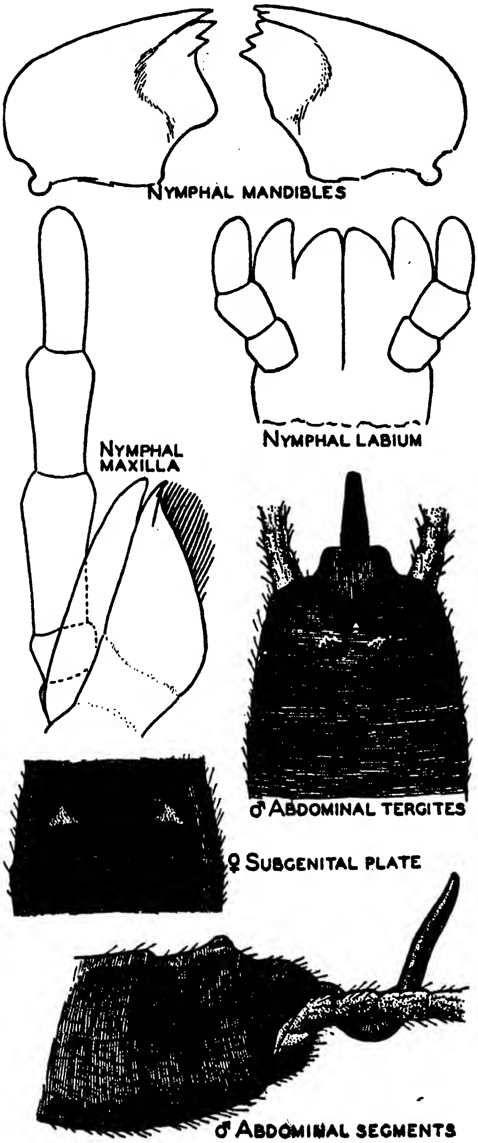


Fig. 29.—*Nemocapnia carolina* from North Carolina.

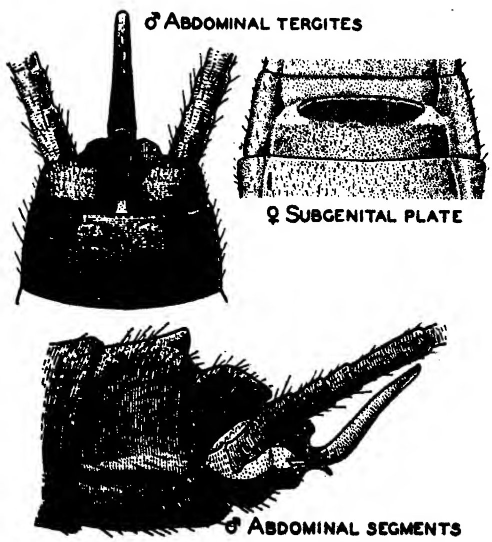


Fig. 30.—*Nemocapnia carolina* from Illinois and Indiana.

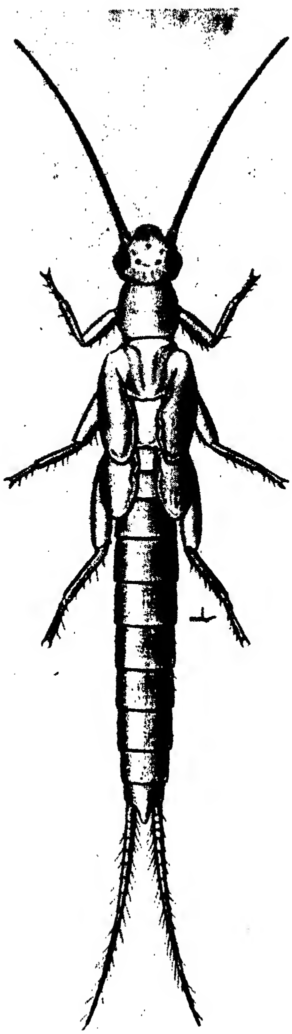


Fig. 31.—Nymph of *Nemocapnia carolina.*

1940, C. O. Mohr & B. D. Burks, 1♀; April 16, 1936, H. H. Ross & C. O. Mohr, 1♂; April 21, 1936, T. H. Frison & C. O. Mohr, 1♀; April 14, 1940, C. O. Mohr & B. D. Burks, 2♀. SHOALS, White River: April 5, 1940, C. O. Mohr & B. D. Burks, 1♀.

VIRGINIA.—SOUTH HILL, Roanoke River: Feb. 16, 1937, ♂♂, ♀♀. REMINGTON, Rappahannock River: March 21, 1940, T. H. Frison *et al.*, ♂♂, ♀♀, nymphs and exuviae. RUCKERSVILLE: March 21, 1940, T. H. Frison *et al.*, 1♂. LYNCHBURG, Elk Creek: March 22, 1940, T. H. Frison *et al.*, 8♂, 6♀. RICHMOND, Robert E. Lee Bridge: 1♀.

Capnia opis (Newman)

Chloroperla opis Newman (1839, p. 89). Original description, ♂, ♀.

Capnia vernalis Needham & Claassen (1925, p. 256). Misidentification.

Capnia opis Ricker (1938, p. 134). Proper synonymy revealed.

Ricker (1938) has shown that *opis* is the same species as that redescribed and recorded by Needham & Claassen (1925) as *vernalis* Newport (1851). Reference to the specific name of *opis* by Needham & Claassen (1925) and by Claassen (1928) is entirely omitted.

Ricker (1938) further states that *vernalis* is not a synonym of *opis* but a distinct species. Thus far, among the numerous specimens of *Capnia* that I have examined from North America, I have been unable to recognize more than one species, *opis* (= *vernalis* in the sense of Needham & Claassen), of *Capnia* from eastern North America. If *vernalis* is a distinct species, as Ricker states, I am unfamiliar with it, and it must have a much different general distributional range than *opis.* Experience with long series of specimens unquestionably of the same species has shown me that slight variations in structural characters are to be expected, and it is probable that specimens I consider within the limits of variation of *opis* are comparable to the specimens which Ricker (1938) considered a separate species by the name of *vernalis.* Fig. 32 shows structural characters of specimens of *opis* taken from Illinois.

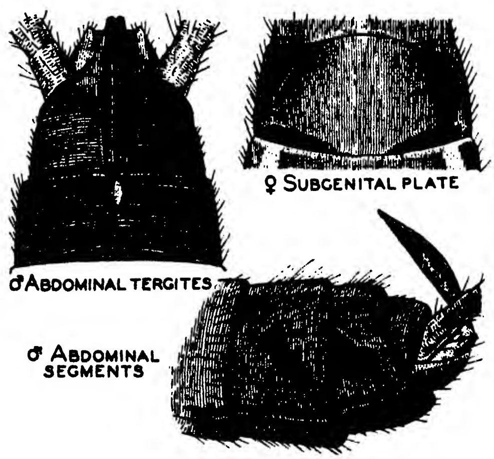


Fig. 32.—*Capnia opis.*

Capnia opis was originally described from specimens collected in Newfoundland, and Needham & Claassen (1925) have added records, under the name of *vernalis,* from New

York and Michigan. Additional records for this species are as follows.

ILLINOIS.—ELGIN: Botanical Gardens, March 20, 1940, B. D. Burks, 1 exuvia; Trout Springs, March 7, 1940, Mohr & Burks, 2♂, 1♀, 2 nymphs, 2 exuviae.

CONNECTICUT.—DANIELSON: March 24, 1937, H. H. Ross, 2♂, 3♀.

MARYLAND.—KEYSER RIDGE: April 19, 1938, H. H. Ross, 4♀; Dec. 30, 1934, T. H. Frison & H. H. Ross, 12 nymphs.

MICHIGAN.—ONTONAGON COUNTY, Shore of Lake Superior between Silver City and Ontonagon: May 15, 1935, J. W. Leonard, ♂♂, ♀♀. CRAWFORD COUNTY, Au Sable River: March 20, 21 and 23, 1936, J. W. Leonard, 3♂, 8♀.

NEW YORK.—CLINTON: March 25, 1903, 3♂. POMPEY CENTER: April 11, 1937, H. H. Ross, 1♀. EAST WINFIELD: April 11, 1937, H. H. Ross, 1♀. DEANSBURG: April 11, 1937, H. H. Ross, 3♂.

NORTH CAROLINA.—Near Grandfather Mountain, west of BLOWING ROCK: March 23, 1940, T. H. Frison *et al.*, 3♂, 2♀.

OHIO.—BLACKLICK: Nov. 5, 1936, L. S. Roach, 4 nymphs. HOCKING COUNTY: March 22, 1938, D. J. & J. N. Knull, 1♀.

ONTARIO.—GLEN MAJOR: April 7, 1934, F. P. Ide, 1♂, 1♀.

PENNSYLVANIA. — EBENSBURG: March 23, 1937, H. H. Ross, 1♀, 6 nymphs. RIVERSIDE: March 22–28, 1937, H. H. Ross, 3♂, 3♀.

QUEBEC. — LAURENTIDES NATIONAL PARK, Long Lake: June 20, 1938, C. Gauthier, 1♀.

TENNESSEE.—GREAT SMOKY MOUNTAINS NATIONAL PARK, Greenbrier Cove: March 15, 1938, A. C. Cole, 2♀.

VIRGINIA.—GORE: March 17, 1940, T. H. Frison *et al.*, 3♀. STANDARDSVILLE: March 21, 1940, T. H. Frison *et al.*, 1♀. SPERRYVILLE: March 17, 1940, T. H. Frison *et al.*, 9♂, 5♀. ELKTON, Elk Run: March 21, 1940, T. H. Frison *et al.*, 3♂, 2♀, exuviae. SKYLINE DRIVE, Big Meadows: March 18, 1941, B. D. Burks, 7♂, 2♀.

WEST VIRGINIA.—ERWIN, Wolf Creek and tributary of Cheat River: ♂♂, ♀♀. KANETOWN: 2♂, 1♀. AUGUSTA, Little Cacapon River: 1♂, 3♀. EVANSVILLE: ♂♂, ♀♀. MACOMBER, Cheat River: ♂♂, ♀♀, exuviae. FELLOWSVILLE: ♂♂, ♀♀, 1 nymph. All collected March 16 and 17, 1940, by T. H. Frison *et al.*

WISCONSIN. — SPOONER, Namakagon River: April 29, 1939, T. H. Frison & B. D. Burks, 1♂, 2♀.

Allocapnia Claassen

Since my paper on Illinois stoneflies (1935*a*), another species of this genus has been found in Illinois, and the study of previously overlooked typic specimens makes necessary some nomenclatorial changes. These changes and additional notes, new descriptions and comments are included in the following discussions of various species of *Allocapnia.*

Allocapnia vivipara (Claassen)

Capnella vivipara Claassen (1924, p. 46). Original description, ♂, ♀.

Capnia minima ? Walsh (1862, p. 367). New synonymy.

Discovery of a specimen of *Allocapnia* in the collection of the Academy of Natural Sciences of Philadelphia unquestionably labeled as "*Capnia minima* ? Newport" by Walsh (1862) confirms my supposition (1935*a*) that this record referred to a species of *Allocapnia.* The tip of the abdomen of this specimen is missing so that it cannot be named to species, but since Walsh referred to a species with rudimentary wings, my original placement (1935*a*) of this record under *vivipara* now seems conclusive.

To date, *vivipara* has been recorded from the states of Illinois, Missouri, New York and Ohio (Frison 1935*a*). I now have many additional records of this species from the states of Indiana, Iowa, Kansas, Kentucky, Oklahoma, Pennsylvania, Tennessee, Virginia and West Virginia. Evidently this species is widely distributed throughout eastern and central North America.

Allocapnia pygmaea (Burmeister)

Semblis pygmaea Burmeister (1839, p. 874). Original description.

Perla nivicola Fitch (1847, p. 278). Original description, ♂, ♀. In part.

Capnella pygmaea Needham & Claassen (1925, p. 277). Redescribed.

Allocapnia torontonensis Ricker (1935*b*, p. 257). New synonymy.

In two of my papers dealing with Illinois stoneflies (1929 and 1935*a*), one species of *Allocapnia*, very abundant in southern Illinois, has been referred to under the name of *pygmaea* (Burmeister), and its identification as this species was at one time checked by Claassen. Since then it has become quite evident to me that two species have been confused under the name *pygmaea* and that, due to the erroneous assignment of certain Illinois material to *pygmaea*, Ricker (1935*b*) was wrongly influenced by me to describe some Ontario specimens of *Allocapnia* as a new species by the name of *torontonensis*.

A restudy of material identified as *pygmaea* by Claassen and the redescription of this species by Needham & Claassen (1925) convince me that *pygmaea*, a species with a long-headed supra-anal process, fig. 33, is identical with *torontonensis*. The Needham & Claassen (1925) concept

of *pygmaea* is based upon a lectotype selected by them after a study of two of Burmeister's cotypes in the Berlin Zoological Museum of Germany, and, even though material identified by Needham &

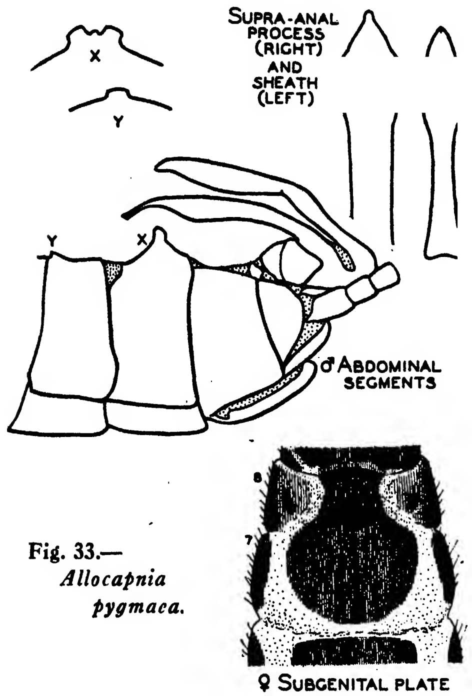


Fig. 33.—*Allocapnia pygmaea.*

Claassen as *pygmaea* may include other related species (such as the new species formerly going under the name *pygmaea* in Illinois), their selection of a lectotype from the mixed cotypic series has definitely established the use of the name *pygmaea* to the species here under consideration.

In the U. S. National Museum are specimens of *Allocapnia* which undoubtedly represent typic specimens of "*Perla nivicola* Fitch." These specimens and notes on their identity are as follows:

1♂, Fitch No. 7,711 = *Allocapnia incisura* Claassen (with Fitch label of *P. nivicola*).

1♂, Fitch No. 7,712 = *Allocapnia incisura* Claassen.

1♂, Fitch No. 4,232 = *Allocapnia* (in such poor condition that specific identification is impossible).

1♀, Fitch No. 4,271 = *Allocapnia* (in such poor condition that specific identification is impossible).

1 (sex?), Fitch No. 10,058 = *Allocapnia* (in such poor condition that specific identification is impossible).

1♂, Fitch No. 10,060 = *Capnia opis* (Newman) (without Fitch label of identification).

In the Museum of Comparative Zoology are the following additional typic specimens (M.C.Z. 10,114) of "*Perla nivicola* Fitch," which have "Hagen" labels and undoubtedly are specimens sent to Hagen by Fitch:

1♂, Fitch No. 4,224 = *Allocapnia pygmaea* (Burmeister).

1♀, Fitch No. 4,234 = *Allocapnia pygmaea* (Burmeister).

1♀, Fitch No. 4,235 = *Allocapnia pygmaea* (Burmeister).

For nomenclatorial reasons it is highly desirable to select a **lectotype** from this mixed typic series of *nivicola*, and I now so designate the male specimen, Fitch No. 4,224, in the Museum of Comparative Zoology.

Since this particular **lectotypic** specimen is of the same species as *pygmaea* (Burmeister) in the sense of Needham & Claassen (1925), who studied the types of *pygmaea* now in the Berlin Zoological Museum, it follows that *nivicola* falls in synonymy to *pygmaea*. The **lectotype** of *nivicola* has been selected from the specimens in the Museum of Comparative Zoology collections because the series of Fitch specimens there are unmixed as to species, and all have early Fitch numbers. Furthermore, if any of the Fitch specimens in the U. S. National Museum were selected, the nomenclatorial changes involved would be greater. Although Banks (1907) listed *nivicola* as a synonym of *pygmaea*, the name *nivicola* was completely omitted by Needham & Claassen in 1925 and again overlooked by Claassen (1928) when a list of names omitted from the earlier monographic treatise was published. In Claassen's (1940) recently posthumously published *Catalogue*, *nivicola* is listed as a synonym of *pygmaea*, and the present **lectotypic** designation definitely establishes this assignment.

It may seem surprising to some that Fitch would include under one species at least three species of capniids. That he did so is not strange, however, considering that in general capniids present a very homogeneous appearing group and that the characters now used for recognizing the various species of these insects were not known or used in 1847. Furthermore, it is a very common experience in collecting winter stoneflies to collect three or four species of capniids at the same time and place, which is evidently what Fitch did.

Recognizing *torontonensis* as a synonym of *pygmaea*, as I now do, and considering

the latter specific name to be associated with a species having a long-headed supra-anal process, I find the Illinois material previously recorded as *pygmaea* without a specific name—a nomenclatorial detail cared for by naming it as *rickeri* in this paper.

Since the Illinois record for the true *pygmaea* represents a new addition to the Illinois faunal list, illustrations of the most important structural characters useful in determining the species are given in fig. 33.

Allocapnia pygmaea was described from specimens taken in Pennsylvania, and Needham & Claassen (1925) give additional records from the District of Columbia, Maryland, Massachusetts, Maine, New Hampshire, New York and Virginia. Ricker's (1935) specimens of *pygmaea* (= *torontonensis*) were from Ontario. To these records I can now add the following.

ILLINOIS.—FOX RIDGE STATE PARK, Dry Run Creek: Feb. 14 and 25, 1938, T. H. Frison & C. O. Mohr, 3♂.

CONNECTICUT.—DANIELSON: March 24, 1937, H. H. Ross, 1♂, 1♀. EAST HAMPTON, Lyman's Brook: March 24, 1937, H. H. Ross, 1♀. MIDDLEBURY, Eight Mile Brook: March 24, 1937, H. H. Ross, 1♂, 1♀. POMFRET, Marshamoquet Brook: March 24, 1937, H. H. Ross, 6♂, 10♀. SANDY HOOK: March 24, 1937, H. H. Ross, 3♀. SOUTHBURY, Kansatonic River: March 24, 1937, H. H. Ross, 1♂, 12♀. WATERBURY, Bristol Park: March 24, 1937, H. H. Ross, 2♂, 2♀.

DISTRICT OF COLUMBIA.—WASHINGTON, Potomac River: Arlington Bridge, Feb. 15, 1937, 1♀; Jan. 23, 1938, B. D. Burks, ♂♂, ♀♀; Feb. 5, 1938, Gurney & Burks, 2♂, 2♀; Feb. 19, 1938, B. D. Burks, 1♂, 1♀; March 13, 1938, B. D. Burks, 1♂.

GEORGIA.—BLAIRSVILLE: Jan. 4, 1939, Frison & Burks, 7♂, 6♀. YOUNG HARRIS: Jan. 4, 1939, Frison & Burks, 5♂, 2♀.

INDIANA.—Creek southwest of BACON: Feb. 14, 1938, Frison & Mohr, 10♂. Creek east of MARENGO: Feb. 14, 1938, Frison & Mohr, 2♂. SPRINGVILLE: Feb. 14, 1938, Frison & Mohr, 2♂.

MARYLAND.—CUMBERLAND, 10 miles east: Feb. 13, 1938, R. E. Yeatter, ♂♂, ♀♀. EMMITSBURG: Feb. 14, 1937, 3♂, 2♀. EVITTS CREEK, North Branch: Dec. 30, 1934, Frison & Ross, 1♂. FLINTSTONE, Flintstone Creek: Dec. 30, 1934, Frison & Ross, 14♂, 2♀. FLINTSTONE, Town Creek: Dec. 30, 1934, Frison & Ross, 4♂, 2♀. GRANTSVILLE, Shade Run: Feb. 13, 1938, R. E. Yeatter, 11♂. HANCOCK, Bear Creek: Dec. 30, 1934, Frison & Ross, ♂♂, ♀♀. HANCOCK, Tonsloway River: Dec. 30, 1934, Frison & Ross, 8♂. PINEY GROVE: Dec. 30, 1934, Frison & Ross, 11♂, 2♀. PRIESTS BRIDGE: Feb. 25, 1938, B. D. Burks, 1♂, 2♀.

MASSACHUSETTS.—WESTBROOK: April 4, 1937, J. F. Hanson, 3♂, 2♀. SHREWSBURY: April 10, 1937, H. H. Ross, 3♀.

MICHIGAN.—CRAWFORD COUNTY, Au Sable River: March 20–21, 1936, J. W. Leonard, 1♂, 1♀; March 23, 1936, J. W. Leonard, 1♂, 1♀. GRAND TRAVERSE COUNTY, Boardman River: May 7, 1935, J. W. Leonard, 1♀. KENT COUNTY: Bear Creek, April 5, 1939, J. W. Leonard, 2♀; Rogue River, April 5, 1939, J. W. Leonard, 1♀. MONTMORENCY COUNTY, Hunt Creek: April 14, 1939, J. W. Leonard, 1♀. PRESQUE ISLE COUNTY: June 24, 1936, J. W. Leonard, 11♀.

MINNESOTA.—LAKE COUNTY: March 26, 1938, W. S. Chalgren (No. 106), 57♂; March 26, 1938, W. S. Chalgren (No. 124), 47♀. SAVAGE: Feb. 5, 1940, P. Harden (No. 129), 7♀; Feb. 5, 1940, P. Harden (No. 128), 8♂.

NEW YORK.—CAZENOVIA: April 11, 1937, H. H. Ross, 3♀. DEPEW: April 13, 1937, H. H. Ross, 3♀. ITHACA: March 11, 1935, J. W. H. Rehn, 2♀; Beebe Lake, March 24, 1937, Mary E. Davis, 1♂, 1♀; same date, H. I. Scudder, 1♂, 1♀; same date, J. W. H. Rehn, Lot 770, ♂♂, ♀♀. LAFAYETTE: April 11, 1937, H. H. Ross, 3♂, 1♀. POMPEY CENTER: April 11, 1937, snow storm, H. H. Ross, 1♀.

NORTH CAROLINA.—BALSAM: Jan. 3, 1939, Frison & Burks, ♂♂, 6♀, mating pairs. BLOWING ROCK: March 23, 1940, Frison, Mohr & Hawkins, 4♂. CRUSO: Jan. 3, 1939, Frison & Burks, mating pairs, ♂♂, 2♀. SIOUX, Cane River: Jan. 2, 1939, Frison & Burks, 5♂, 5♀. SHOOTING CREEK: Jan. 3, 1939, Frison & Burks, 6♂, 1♀. RAINBOW SPRINGS: Jan. 3, 1939, Frison & Burks, 6♂, 1♀. WOODROW, Pigeon River: Jan. 3, 1939, Frison & Burks, ♂♂, ♀♀, mating pairs.

OHIO.—ASH CAVE: March 6, 1938, T. H. Frison, 29♂. ATHENS, Margaret Creek, March 6, 1938, T. H. Frison, 1♂. CARBONDALE: March 6, 1938, T. H. Frison, 6♂, 2♀. COOLVILLE, tributary of Hocking River: March 16, 1940, T. H. Frison *et al.*, ♂♂, 5♀. HUNTSBURG, 2 miles east: Feb. 18, 1938, R. E. Yeatter, 1♀. MOUNT PLEASANT: March 6, 1938, T. H. Frison, 1♀.

PENNSYLVANIA.—AMITY HALL, Route U. S. 22: Feb. 17, 1938, R. E. Yeatter, 1♂, 1♀. DAUPHIN: Feb. 13, 1937, 6♂, 1♀. EMERICKVILLE, 1½ miles east: Feb. 18, 1938, R. E. Yeatter, ♂♂, ♀♀. HUGHESVILLE, Muncy Creek: Feb. 13, 1937, P. W. C., ♂♂, ♀♀. LEWISTOWN, Jack's Creek: March 23, 1937, H. H. Ross, 1♂, 1♀. ORCHARD BEACH: April 13, 1937, H. H. Ross, 2♂, 2♀. PICTURE ROCKS, Muncy Creek: Feb. 13, 1937, ♂♂, 4♀. VAN, East Sandy Creek: Feb. 18, 1938, R. E. Yeatter, 1♂, 1♀.

TENNESSEE.—DUCKTOWN, 8 miles west: Jan. 4, 1939, Frison & Burks, ♂♂, ♀♀, mating pairs. ERWIN: Jan. 2, 1939, Frison & Burks, 9♂, 1♀. PARKSVILLE, branch of Ocoee River: Jan. 4, 1939, Frison & Burks, mating pairs, ♂♂, ♀♀.

VIRGINIA.—AFTON: March 22, 1940, Frison, Mohr & Hawkins, 1♂, 2♀. ELKTON, Elk River: Jan. 1, 1939, Frison & Burks, 3♂. ELLISTON, Roanoke River: Jan. 2, 1939, Frison & Burks, 1 mating pair, ♂♂, 5♀. GORE: March 17, 1940, T. H. Frison *et al.*, 1♀. MADISON: Jan. 1, 1939, Frison & Burks, ♂♂, 2♀; Crooked Run Creek, Jan. 1, 1939, Frison & Burks, 3♂, 3♀. MARION, Holston River: Jan.

2, 1939, Frison & Burks, ♂♂, 1♀. MIDMOUNT: Jan. 1, 1939, Frison & Burks, 1♂. RUCKERSVILLE, Rapidan River: March 21, 1940, Frison, Mohr & Hawkins, 3♀. SHELBY, Rapidan River: Jan. 1, 1939, Frison & Burks, mating pair, ♂♂, 9♀. SPERRYVILLE: March 17, 1940, T. H. Frison *et al.*, 6♂, ♀♀. WINCHESTER, Hogue Creek: March 17, 1940, T. H. Frison *et al.*, 5♂, 4♀.

WEST VIRGINIA.—AUGUSTA, Little Cacapon River: March 17, 1940, T. H. Frison *et al.*, ♂♂, ♀♀ (2♂, 2♀, mating pairs). CAPON BRIDGE, Cacapon River: March 17, 1940, T. H. Frison *et al.*, 3♂, ♀♀. ERWIN: tributary of Cheat River, March 16, 1940, T. H. Frison *et al.*, 5♂, 5♀; Wolf Creek, March 16, 1940, T. H. Frison *et al.*, 5♀. EVANSVILLE: March 16, 1940, T. H. Frison *et al.*, 5♂, 5♀. FELLOWSVILLE: March 16, 1940, T. H. Frison *et al.*, 1♂, 2♀. IAEGER, Horse Creek: Jan. 1, 1936, John Addair, 8♂, 1♀; Feb. 2, 1936, John Addair, 10♂, 8♀. KANETOWN: March 16, 1940, T. H. Frison *et al.*, 5♂, 6♀. MACOMBER, Cheat River: March 17, 1940, T. H. Frison *et al.*, ♂♂, 9♀. ROMNEY: March 17, 1940, T. H. Frison *et al.*, ♂♂, 8♀.

WISCONSIN.—WHITCOMB: April 8, 1937, Frison & Mohr, 2♀. WITTENBERG: April 8, 1937, Frison & Mohr, 1♂, 1♀.

Allocapnia curiosa new species

MALE.—Body and appendages mostly dark brown to black with pale, membranous areas. No gill remnants.

Head through compound eyes wider than pronotum. Ocelli arranged to form an isosceles triangle; the anterior ocellus situated well forward on the front, the lateral ocelli almost three times as far apart as distance from each lateral ocellus to inner margin of compound eye. Maxillary palpi less than thickness of basal flagellar segments.

Pronotum quadrangular, surface with a narrow, median, longitudinal, depressed stripe and indistinct, raised rugosities. Wings somewhat abbreviated, forewings extending to sixth tergite, hyaline with veins dark brown.

Abdomen with tergites seven and beyond, fig. 34, darker and more heavily sclerotized than those preceding; first four to five tergites with a narrow, median, pale, longitudinal, membranous-like stripe; seventh tergite with a tubercle in middle of anterior half and with its tip slightly directed rearwards; eighth tergite with a small anterior tubercle in middle area and a tall, transverse one on posterior margin, which is notched in middle to form two points, ninth tergite slightly cleft for reception of supra-anal process; recurved supra-anal process shaped as in fig. 34; ninth sternite without a lobe at the base.

FEMALE.—Similar in most morphological features to the male. Wings not abbreviated and extending to or beyond tip of abdomen; a wide, median, dorsal, longitudinal stripe extending from base of abdomen to hind margin of eighth tergite,

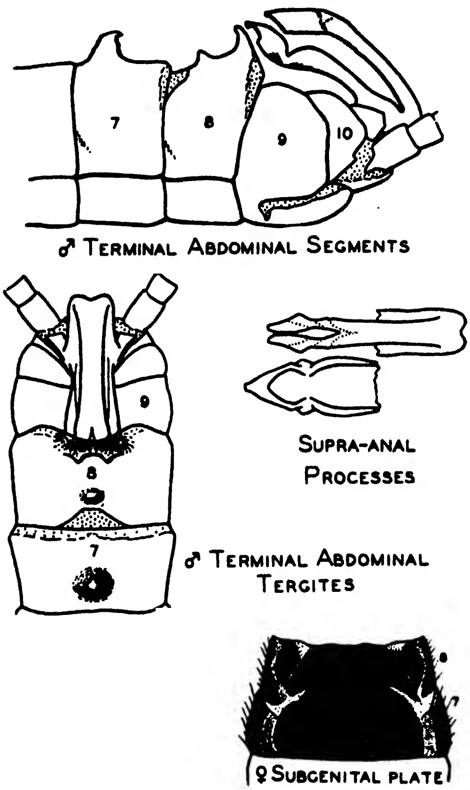


Fig. 34.—*Allocapnia curiosa.*

last two tergites entirely and darkly sclerotized; seventh abdominal sternite, fig. 34, convexly swollen, with posterior median margin produced lobelike backwards over eighth sternite, posterior margin of seventh beneath lobelike projection and anterior margin of eighth sternite apparently fused at certain points of contact; eighth sternite with posterior margin straight, without any special structure, but somewhat recessed.

Holotype, male.—Kanetown, W. Va.: March 16, 1940, T. H. Frison *et al.*

Allotype, female.—Same data as for holotype.

Paratypes.—WEST VIRGINIA.—KANETOWN: Same data as for holotype, 20♂, 2♀, including

a mating pair. ROMEY: March 17, 1940, T. H. Frison *et al.*, 3♂, 3♀. IAEGER, Horse Creek: Feb. 2, 1936, J. Addair, 1♂.

MARYLAND.—GRANTSVILLE, Shade Run: Feb. 13, 1938, R. E. Yeatter, 1♂.

This species is easily distinguished from all other species of *Allocapnia.* The males, in having a tubercle on the seventh abdominal tergite, suggest *forbesi* Frison and *illinoensis* Frison, but the shape and general arrangement of all tubercles is quite different. The females are unique because of the pronounced lobelike projection of the posterior margin of the seventh sternite. The seventh and eighth sternites are slightly fused beneath the lobelike projection of the seventh sternite, but this attachment is readily broken so that a membranous transverse strip may seem to be present between these sternites beneath the lobe.

Allocapnia virginiana new species

MALE.—Similar in general features to *curiosa* Frison. Differs from this and other species of the genus as follows. Abdomen with first seven tergites without tubercles, a narrow, median, pale, longitudinal, membranous-like stripe on first four basal tergites; eighth tergite, fig. 35, with a large, odd-shaped, robust tubercle which in turn has a small, pointed tubercle on anterior face or margin; recurved supra-anal process very short, broad and shaped as in fig. 35; ninth and tenth tergites broadly cleft for reception of supra-anal process.

FEMALE.—Similar in most morphological features to the male. Wings extending to tip of abdomen; a wide, median, dorsal, longitudinal stripe extending from base of abdomen to hind margin of eighth tergite, last two tergites entirely and darkly sclerotized; seventh abdominal sternite similar to those preceding; eighth abdominal sternite with a darkly sclerotized subgenital plate shaped as in fig. 35.

Holotype, male.—Shelby, Rapidan River, Va.: Jan. 1, 1939, T. H. Frison & B. D. Burks.

Allotype, female.—Same data as for holotype.

Paratypes.—VIRGINIA.—SHELBY: Same data as for holotype, 2♂, 4♀. MADISON: Jan. 1, 1939, T. H. Frison & B. D. Burks, 1♂, 6♀. REMINGTON, Rappahannock River: Dec. 31, 1938, T. H. Frison & B. D. Burks, 2♂, 2♀.

The shape of the supra-anal process and structures on the eighth abdominal tergite separate the male of this species from males of all other known species of *Allocapnia.* The female of this new species

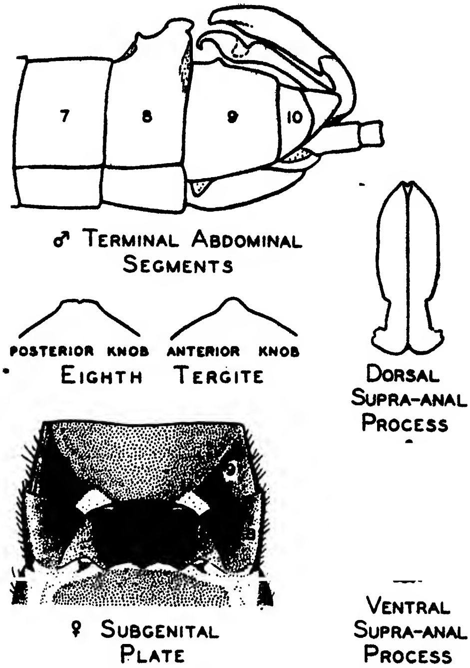


Fig. 35.—*Allocapnia virginiana.*

belongs to the group of species having only the last two dorsal abdominal tergites darkly sclerotized and with a pale, membranous, transverse stripe between the seventh and eighth abdominal sternites; it differs, however, in shape of subgenital plate. The male and female are associated on the basis of their collection together at the same time at three different localities.

Allocapnia rickeri new species

Allocapnia pygmaea Frison (1929, p. 396). Misidentification.

Allocapnia pygmaea Frison (1935*a*, p. 367). Misidentification.

As mentioned in the discussion under *pygmaea* (Burmeister), certain Illinois specimens of *Allocapnia* once recorded by me (1929 and 1935*a*) as *pygmaea*, and also many similar specimens in the Illinois Natural History Survey collection from other localities, require a new specific name. I propose, therefore, for this species of *Allocapnia* the name of *rickeri* in honor of Dr. William E. Ricker, who

has considerably contributed to our knowledge of North American stoneflies.

The morphological characters of *rickeri*, excepting those in which it differs from the true *pygmaea*, have been fairly well covered in my 1929 and 1935*a* papers under the name of *pygmaea*. It seems necessary

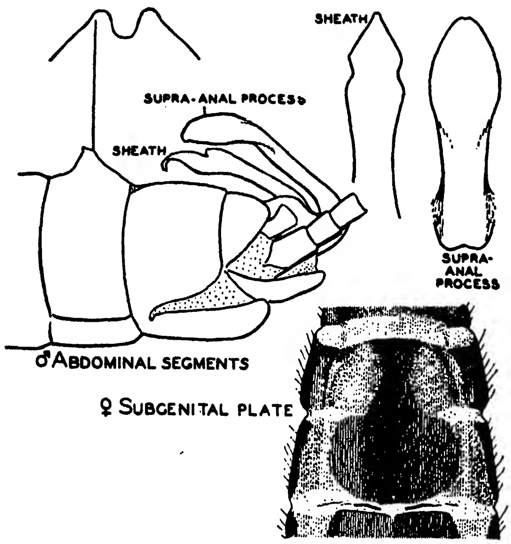


Fig. 36.—*Allocapnia rickeri.*

to present here, therefore, only a brief review of the most salient characters needed for recognition of *rickeri* and new illustrations for comparison with those of the true *pygmaea.*

MALE.—Similar in general features to *curiosa* Frison as described in this paper. Certain characters peculiar to *rickeri* and separating it from other species are as follows: Wings short and usually extending about half the length of abdomen; seventh abdominal tergite without suggestion of any tubercle, eighth tergite with two rather low and definitely separated tubercles, ninth and tenth tergites with middle area depressed and membranous for reception of supra-anal process; supra-anal process, fig. 36, with a short head.

FEMALE.—Similar in most morphological features to the male. Wings reaching about to or slightly beyond tip of abdomen; a wide, median, dorsal, longitudinal stripe extending from base of dorsum of abdomen to hind margin of eighth tergite, last two tergites entirely and darkly sclerotized; seventh and eighth abdominal sternites fused in middle and without transverse membranous strip between them; subgenital plate shaped as in fig. 36.

Holotype, male.—Golconda, Big Grand Pierre River, Ill.: March 7, 1928, T. H. Frison & H. H. Ross.

Allotype, female.—Same data as for holotype.

Holotype and allotype represent a mating pair.

Paratypes.—ILLINOIS.—Apple River, northwest of APPLE RIVER CANYON STATE PARK: March 2, 1938, Ross & Mohr, 112♂, 27♀. BLOOMFIELD: March 7, 1928, on concrete foundation of bridge, Frison & Ross, 13♂, 2♀. DIXON SPRINGS: Feb. 2, 1934, Frison & Mohr, 54♂, 2♀, 1 mating pair. EICHORN: March 6, 1928, Frison & Ross, 42♂, 8♀; Buck Creek, on bridge, Frison & Ross, 21♂, 11♀. GOLCONDA, Big Grand Pierre River, on and near bridge: March 7, 1928, Frison & Ross, 75♂, 32♀, 4 mating pairs. GORHAM: Feb. 3, 1934, Frison & Mohr, 1♂, 1♀. HEROD: Gibbons Creek, under bark of tree hanging over stream, March 6, 1928, Frison & Ross, 3♂; Gibbons Creek, on stones and debris in and near margin of stream, 47♂, 30♀, 1 mating pair; April 19, 1937, Ross & Mohr, 1♀; Rose Creek, foundation of concrete bridge, March 6, 1928, Frison & Ross, 1 mating pair; Big Grand Pierre River, foundation of concrete bridge, March 6, 1928, Frison & Ross, 1♀. HEROD-ELIZABETHTOWN, Hicks Branch Creek: March 6, 1938, Frison & Ross, 3♂. JONESBORO: Feb. 3, 1934, Frison & Mohr, 50♂, 4♀. NEW COLUMBIA, Clifty Creek: Dec. 26, 1932, Harper, 4♂. THEBES: Feb. 3, 1934, Frison & Mohr, 4♂. VIENNA, on concrete foundation of bridge: March 7, 1928, Frison & Ross, 1♂. WARREN, tributary of Apple River: March 2, 1938, Ross & Mohr, 111♂, 8♀.

Other specimens of this species examined, but not included in paratypic series, are as follows.

ILLINOIS.—GOLCONDA, Big Grand Pierre River: March 7, 1928, Frison & Ross, many nymphs.

DISTRICT OF COLUMBIA.—WASHINGTON, Potomac River: Feb. 5, 1938, Gurney & Burks, 1♂.

INDIANA.—BACON: creek southwest of town, Feb. 14, 1938, Frison & Mohr, ♂♂, ♀♀, 3 mating pairs; Patoka River northwest of town, Feb. 14, 1938, Frison & Mohr, ♂♂, ♀♀. ENGLISH, creek north of town: Feb. 14, 1938, Frison & Mohr, ♂♂, ♀♀, 1 mating pair. MCCORMICK CREEK STATE PARK: March 14, 1936, Frison & Ross, ♂♂, ♀♀. MARENGO, creek west of town: Feb. 14, 1938, Frison & Mohr, ♂♂, 2♀. MEDORA, creek northwest of town: Feb. 14, 1938, Frison & Mohr, 2♂. MILLTOWN, creek west of town: Feb. 14, 1938, Frison & Mohr, 8♂, 1♀. NEEDMORE, creek near town: March 14, 1936, Frison & Ross, ♂♂, ♀♀, 3 mating pairs. PALMYRA, Blue River north of town: Feb. 14, 1938, Frison & Mohr, ♂♂, ♀♀. PAOLI, south of town: Feb. 14, 1938, Frison & Mohr, ♂♂, ♀♀, many mating pairs. SALEM, river south of town:

Feb. 14, 1938, Frison & Mohr, 6♂, 4♀. SPRINGVILLE: Feb. 14, 1938, Frison & Mohr, ♂♂, ♀♀. TURKEY RUN STATE PARK: March 18, 1933, Frison & Mohr, 1♀; Sugar Creek, April 19, 1933, Frison & Mohr, 2♀. WILLOW VALLEY: March 14, 1936, Frison & Ross, ♂♂, 1♀.

KENTUCKY.—TRENTON: Jan. 5, 1939, Frison & Burks, ♂♂, 6♀.

MARYLAND. — EMMITSBURG: Feb. 14, 1937, 8♂, 3♀. INDIAN SPRINGS: Feb. 2, 1936, Frison & Ross, 1♂, 3♀.

NEW YORK.—ITHACA: March 15, 1922, 2♂, 2♀; Beebe Lake, March 18, 1935, 1♀. NORTH COLLINS: April 13, 1937, H. H. Ross, 1♂.

OHIO.—LITTLE HOCKING, White Run Creek: March 16, 1940, T. H. Frison *et al.*, 3♂, 1♀. NEW CONCORD: Jan. 6, 1935, H. H. Ross, ♂♂, 3♀.

PENNSYLVANIA.—AMITY HALL, on Route U. S. 22: Feb. 17, 1938, R. E. Yeatter, ♂♂, 6♀. CLAYSVILLE, 5 miles east on U. S. 40: Feb. 13, 1938, R. E. Yeatter, 1♀. EMERICKVILLE, 1½ miles east of town: Feb. 18, 1938, R. E. Yeatter, ♂♂, ♀♀. GRAMPIAN, Kratzer Run: Feb. 18, 1938, R. E. Yeatter, 1♂. NORTHUMBERLAND: March 23, 1937, H. H. Ross, ♂♂, 4♀. VAN, East Sandy Creek: Feb. 18, 1938, R. E. Yeatter, ♂♂, ♀♀.

TENNESSEE.—BRISTOL: Jan. 2, 1939, Frison & Burks, 1♂. GOODLETTSVILLE: Jan. 5, 1939, Frison & Burks, 1♂, 1♀. JOHNSON CITY: Jan. 2, 1939, Frison & Burks, ♂♂, 4♀. McDONALD: Jan. 4, 1939, Frison & Burks, ♂♂, 1♀, 2 mating pairs. SPRINGFIELD, Sulphur Fork Creek: Jan. 5, 1939, Frison & Burks, ♂♂, ♀♀.

VIRGINIA.—AFTON: March 22, 1940, Frison, Mohr & Hawkins, ♂♂, 2♀. BULL RUN, Bull Run Creek: March 21, 1940, Frison, Mohr & Hawkins, 1♂. CEDARVILLE: March 17, 1940, T. H. Frison *et al.*, 3♂. CULPEPER, Gaines Run Creek: March 21, 1940, Frison, Mohr & Hawkins, 1♂, 1♀. ELKTON, Elk Run: March 21, 1940, Frison, Mohr & Hawkins, ♂♂, 3♀. ELLISTON, Roanoke River: Jan. 2, 1939, Frison & Burks, 1♂, 1♀. FAIRFAX: Jan. 2, 1935, T. H. Frison, 2♂; Dec. 31, 1938, Frison & Burks, 3 mating pairs; March 21, 1940, Frison, Mohr & Hawkins, 1♂. FAIRFIELD: Jan. 1, 1939, Frison & Burks, ♂♂, ♀♀. FORT CHISWELL: Jan. 2, 1939, Frison & Burks, 1♂, 1♀. GORE: March 17, 1940, T. H. Frison *et al.*, 9♂, 4♀, 3 mating pairs. GREENVILLE, Christian Creek: Jan. 1, 1939, Frison & Burks, ♂♂, 1 mating pair. GROTTOES, Mill Creek: Jan. 1, 1939, Frison & Burks, ♂♂, ♀♀, 6 mating pairs. HUNTER: Jan. 30, 1938, Gurney & Burks, 9♂, 2♀. MARION, Holston River: Jan. 2, 1939, Frison & Burks, 1♀. PORT REPUBLIC: North River, Jan. 1, 1939, Frison & Burks, 2♂, 1♀; March 21, 1940, Frison, Mohr & Hawkins, ♂♂, 1♀, 1 mating pair. RADFORD: Plum Creek, Jan. 2, 1939, Frison & Burks, ♂♂, 6♀, 1 mating pair; March 22, 1940, Frison, Mohr & Hawkins, 3♀. RIVERTON: March 17, 1940, T. H. Frison *et al.*, 2♂, 1♀. ROANOKE, Mud Lick Creek: Jan. 2, 1939, Frison & Burks, 2♀. SHAWSVILLE: Jan. 2, 1939, Frison & Burks, 3♂. VIENNA, Indian Run Creek: Feb. 13, 1938, B. D. Burks, ♂♂, 6♀. WARRENTON: March 21, 1940, Frison, Mohr & Hawkins, 3♂, 2♀. WINCHESTER, Hogue Creek: March 17, 1940, T. H. Frison *et al.*, 4♂, 1♀, 1 mating pair.

WEST VIRGINIA. — EVANSVILLE: March 16, 1940, T. H. Frison *et al.*, 4♂, 4♀. PRUNTYTOWN: March 16, 1940, T. H. Frison *et al.*, 1♂. SHAFFENAKER: March 17, 1940, T. H. Frison *et al.*, 1♂. SMITHBURG: March 16, 1940, T. H. Frison *et al.*, 2♂. VOLCANO: March 16, 1940, T. H. Frison *et al.*, ♂♂, ♀♀.

PERLIDAE

Perlesta placida (Hagen)

Perla placida Hagen (1861, p. 28). Original description, ♂, ♀.

Perlesta placida is one of the most widely distributed species of stoneflies in North America, and large series of specimens from various localities reveal considerable variation. It is not my intention to go into detail in this paper con-

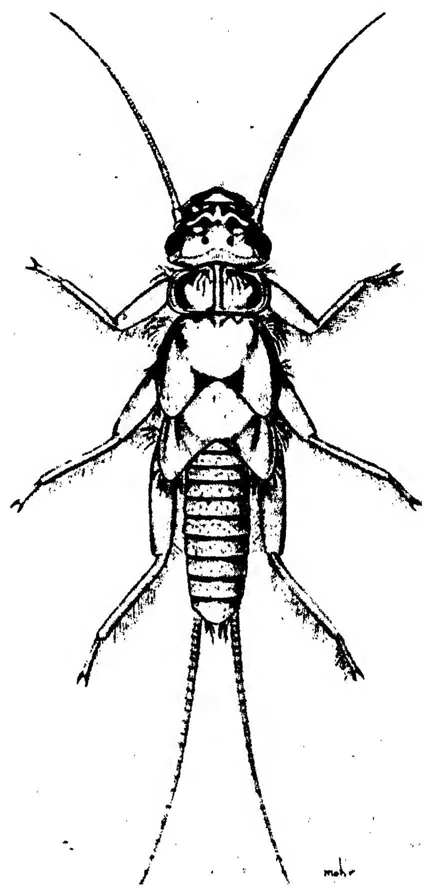


Fig. 37.—Nymph of *Perlesta placida.*

cerning the ramifications of this variation. However, it seems desirable to illustrate a form which is commonly encountered in the Great Smoky Mountains National Park near Gatlinburg, Tenn., because its identity might be overlooked. The nymph of this variant is shown in fig. 37.

Fig. 38*A* is a dorsal view of the head and pronotum of this variant, and fig. 38*B*

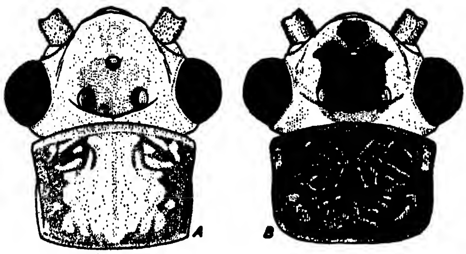


Fig. 38.—*Perlesta placida: A* from Great Smoky Mountains National Park, *B* from lower altitudes.

is the same view of more nearly typical specimens taken at lower elevations. The difference in color pattern is quite noticeable even in old pinned specimens. The nymph of this variant, fig. 37, differs from typical specimens from elsewhere in its generally lighter color and in the comparative absence of numerous short, stout setae which usually give the nymphs a freckled appearance (Frison 1935*a*, figs. 307 and 308).

Acroneuria arida (Hagen)

Perla arida Hagen (1861, p. 18). Original description, ♂, ♀.

Perla valida Banks (1906*a*, p. 32). Original description, ♀. Previously correctly synonymized by Needham & Claassen (1922).

Acroneuria arida Needham & Claassen (1925, p. 185). In part.

Acroneuria arida Claassen (1940, p. 172). *Catalogue*—in part.

Through the courtesy of Dr. Nathan Banks, I have had the privilege of studying in considerable detail the types of *Perla arida* Hagen (1 female, No. 14,386) and *P. valida* Banks (1 female, No. 11, 315), both in the collection of the Museum of Comparative Zoology. Because of the importance of establishing the presence or absence of anal gill remnants on the subanal lobes, the apical abdominal segments of the typic female of *arida* from "Philadelphia—Winthem" were clipped from the abdomen, softened in potassium hydroxide and studied in fluid. The typic female of *valida* is from "Waynesville, N. C., July, 1901, F. Sherman, Jr."

Needham & Claassen (1922) were correct in placing *valida* as a synonym of *arida*, but in 1925 they confused another species with *arida* which led me (1935*a*) to an erroneous assignment of certain Illinois specimens to this species. These Illinois specimens belong to a species which was described later by Claassen (1937*b*), on the basis of a single adult female, as *prolonga*, which in turn is a synonym of *evoluta* Klapálek, as I am now using this name.

Studies of the types involved, the rearing of *evoluta* (= *arida* Frison 1935*a*) and comparisons of extensive material in the Illinois Natural History Survey collection all have established that *evoluta* is a species with anal abdominal gills in the nymph and subanal gill remnants in the adult, and that *arida* (= *valida*) lacks such structures in the adult, and, of course, this means that the nymph when discovered will not possess anal abdominal gills.

A fundamental character for the separation of *arida* from *evoluta*, as now recognized, having been established, the differences previously observed in the shape of the subgenital plate of the females become understandable as specific differences. In *arida*, the subgenital plate is much constricted at its base, fig. 39, so that the end portion is much broader than its base, whereas in *evoluta* the base is not, or but slightly, constricted (Frison 1935*a*, figs. 242–3).

Although Klapálek (1909) records three males and one female of *valida* from "North Carol. Morr." in the Selys Longchamps collection, no description or illustration is given of the male, and it is possible that these specimens, particularly the males, are not *arida*. Klapálek failed to recognize *arida* as a valid species and erroneously placed it in the synonymy of *arenosa* (Pictet).

Since the male of *arida* has not been previously described (Needham & Claassen 1925 description is undoubtedly male of *evoluta*), I present fig. 39 and the following brief description.

MALE.—General habitus the same as for other species of *Acroneuria* from North America. Dorsum of head yellow

with pattern of dark brown markings as in fig. 39. Pronotum with raised rugosities and a narrow, yellow, longitudinal median line. Terminal abdominal tergites with groups of small spinulae arranged as

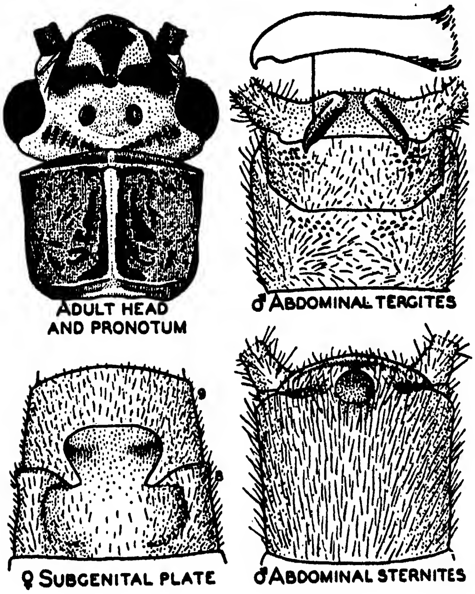


Fig. 39.—*Acroneuria arida.*

in fig. 39. Genital hooks or modified subanal lobes of the finger-like type with a distinct notch on inner margin at tip. Ninth sternite with a small, nearly round, padlike disk. Subanal lobes show no trace of gill remnants.

Allotype, male.—Knoxville, Tenn.: June 21, 1939, A. C. Cole.

The subgenital plate of the female of *arida* was figured by Banks at the time of the original description of *valida*, but to aid recognition of this species another illustration of this structure, fig. 39, is presented.

The nymph of this species has not as yet been discovered.

In addition to the records from North Carolina and Philadelphia (Pennsylvania) given in the original descriptions, I can now add the following.

GEORGIA.—SUMMERVILLE: June 9, 1937, P. W. Fattig, 5♂, 7♀. RINGGOLD, Chickamauga Creek: June 14, 1939, P. W. Fattig, 5♂, 6♀. BALL GROUND: June 27, 1932, P. W. Fattig, 1♀. ELLAVILLE, Cedar Creek, 10.7 miles north: May 26, 1939, P. W. Fattig, 2♀.

TENNESSEE.—KNOXVILLE: April 24, 1936, C. B. Huffaker, 1♀; May 26, 1936, C. B. Huffaker, 1♂; June 1, 1936, D. A. Johnson, 1♂; June 6, 1936, D. A. Johnson, 1♂; May 22, 1939, A. C. Cole, 2♀; June 14, 1939, A. C. Cole, 1♀; June 21, 1939, A. C. Cole, 2♂, 4♀. SEVIERVILLE: June 11, 1938, at light, T. H. Frison & T. H. Frison, Jr., 1♀. GREENBRIER COVE, Smoky Mountains: June–July, 1940, A. C. Cole, 1♂, 1♀. MONTEAGLE: A. C. Richards, 2♀.

Acroneuria evoluta Klapálek

Acroneuria evoluta Klapálek (1909, p. 245). Original description, ♀.

Larva No. 1—Garman (1912, p. 59, fig. 47). Nymphal description.

Acroneuria arida Needham & Claassen (1925, p. 185). In part.

Acroneuria evoluta Clark (1934, p. 121).

Acroneuria arida Frison (1935*a*, p. 395). Misidentification.

Acroneuria prolonga Claassen (1937*b*, p. 42). New synonymy.

Acroneuria evoluta Ricker (1938, p. 138). Notes on type.

Acroneuria arida Claassen (1940, p. 172). *Catalogue*—in part.

In my remarks concerning the synonymy of *arida* (Hagen), I have called attention to the fact that Needham & Claassen (1925) confused two species under the name of *arida*. One of these species, *arida* (Hagen) = *valida* (Banks), lacks gill remnants on the subanal lobes of the adults and hence has nymphs lacking anal abdominal gills. The second of these species has anal abdominal gills in the nymphs and shows gill remnants on the subanal lobes of the adults (*evoluta* = *arida* as used in the sense of Frison 1935*a*).

Due to the confusion of species in literature at the time of publication of my 1935*a* paper, the Illinois records of *arida* reported by me at that time apply to the species here called *evoluta*. It is obvious from this situation that my placement then of *evoluta* as a synonym of *arida* does not hold, and *evoluta* becomes available as the name for this Illinois (1935*a*) material.

Ricker's (1938) notes on the type of *evoluta* are the basis for my use now of the name *evoluta* for the Illinois material recorded (1935*a*) as *arida*. Ricker states that his study of *evoluta* "indicates that it is synonymous with *arida* Hagen, as earlier suggested by Frison." It should be pointed out that at the time of Ricker's article the *arida* in the sense of Frison is not equivalent to the true *arida* (Hagen) but to a species for which the first name available now appears to be *evoluta*.

In 1937, I adopted the use of the name

evoluta for an Illinois species heretofore confused with *arida* as used in the sense of Frison 1935*a*. The transfer now of the name *evoluta* to my *arida* material of 1935*a* leaves the species called *evoluta* in 1937 "without a name," as Ricker (1938) has earlier suggested.

Part of the material listed by Needham & Claassen (1925) as *arida* belongs to the species I am now recognizing as *arida* (= *valida*) and part belongs to the species I am here recognizing as *evoluta*. Clark's (1934) record of *evoluta* from Put-in-Bay, Ohio, mentioned as belonging to *arida* in my 1935*a* paper, again becomes part of the bibliography of *evoluta* as here recognized. Since Garman's (1912) description of "Larva No. 1" and his fig. 47 are equivalent to *arida* in the sense of Frison 1935*a*, it also must be included in the bibliography of *evoluta* as now accepted.

Acroneuria prolonga Claassen (1937*b*) was described on the basis of a single female from "Bridger Mountains, Montana, June 19, 1914." I have studied this type in the collection of Cornell University and consider it to be the same as my *arida* material of 1935*a*, which I am now calling *evoluta* as a result of Ricker's remarks concerning the type. Any differences which might be observed between the subgenital plates of *evoluta*, as now accepted, and *prolonga* are certainly slight and I believe well within the range of individual variation.

For the convenience of other students and the bibliographic record, I have given the complete bibliography of *evoluta* to date. My only question is whether the name of *evoluta* is even now being correctly used, a matter impossible to investigate further at this time.

Acroneuria mela new species

Acroneuria evoluta Needham & Claassen (1925, p. 186). At least in part.
Acroneuria arida Claassen (1931, p. 81, figs. 202 and 207). Nymph.
Acroneuria sp. *a* Frison (1935*a*, p. 405). Nymphal description.
Acroneuria evoluta Frison (1937, p. 79). Additional descriptive material and association of nymph.
Acroneuria evoluta Claassen (1940, p. 173). *Catalogue.*

As already mentioned in connection with *evoluta* Klapálek, it is necessary at this time to give a new specific name to the species illustrated and mentioned by me (1937) under the name of *evoluta*. In my article of 1937, I mentioned the possibility that my use of the name of *evoluta* for certain Illinois material, following its use "by Needham & Claassen (1925) for similar specimens from Kansas," was somewhat dubious. Ricker (1938) has made a recent study of the typic female of *evoluta* in the collection of the Vienna Museum, and he states that it is not the same as the *evoluta* of Frison 1937 but "synonymous with *arida* Hagen [sense of Frison], as earlier suggested by Frison (1935:95)." When Ricker made his study of the type of *evoluta* he had available the published illustrations and descriptions (Frison 1935, 1937) to separate the two Illinois species at one time lumped as *arida*, but was not aware that the true *arida* (Hagen) = *valida* (Banks) was yet another species. This explains his statement of "synonymous with *arida* Hagen."

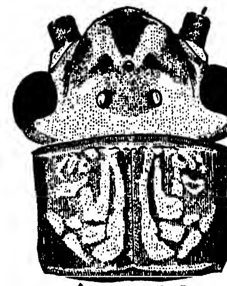


Fig. 40.—*Acroneuria mela.*

Claassen's (1931) reference in his key to the nymph of *arida*, and his drawing (fig. 202) and photograph (fig. 227) of this nymph, should now be assigned to the bibliography of this new species since they are the same as my species *a* of 1935*a* and *evoluta* of 1937.

Since this species has been confused in literature, and since, except for notes and illustrations in my stonefly paper of 1937, no single description certainly applies altogether to this species, I consider it advisable to treat it as a new species rather than to propose a new name as an appendage to previously mixed literature.

MALE.—General habitus the same as for other species of *Acroneuria* from North America. Dorsum of head yellow with a pattern of dark brown markings as in fig. 40. Pronotum with raised rugosi-

ties and a longitudinal, median depressed line. Terminal abdominal tergites with groups or patches of small spinulae arranged as in fig. 64 of Frison 1937. Genital hooks or modified subanal lobes tapering to a point which is curved inwards at tip (fig. 64, Frison 1937). Subanal lobes show gill remnants.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male, but slightly larger in size. Important differences are as follows: eighth abdominal sternite modified into a subgenital plate extending partly over ninth sternite and shaped as in fig. 64 of Frison 1937.

Holotype, female.—Petersburg, Ind.: reared from nymph from White River, June 11, 1936, T. H. Frison & C. O. Mohr.

Allotype, male.—Same data as for holotype except reared June 9, 1936.

Paratypes. — INDIANA.—PETERSBURG: Same data as for holotype and allotype with rearing dates as follows: June 3, 1♂; June 4, 3♀; June 8, 1♂; June 9, 2♂, 3♀; June 10, 2♀; June 13, 3♀; June 15, 5♀; June 22, 1♀; July 6, 1♀.

The female, instead of the male, has been selected as the holotype because it is easier to separate from other species of *Acroneuria* than is the male. The type series has been based upon Indiana specimens only because it is a reared series.

Records for this species in the Illinois Natural History Survey collection not recorded by me (1937) under the name *evoluta* are as follows.

ILLINOIS.—OAKWOOD: June 24, 1937, T. H. Frison, Jr., 1♀. URBANA: July 3, 1938, G. T. Riegel, 1♀. EDDYVILLE, Lusk Creek: June 1, 1940, B. D. Burks, 1♀.

GEORGIA.—SUMMERVILLE: June 9, 1937, P. W. Fattig, 1♀. RINGGOLD, Chickamauga Creek: June 14, 1930, P. W. Fattig, 1♂, 6♀. DALTON: June 14, 1939, P. W. Fattig, 3♀.

KANSAS.—LAWRENCE: June 30, 1921, P.W.C., 1♀ (previously determined by Claassen as *evoluta*).

OHIO.—ADAMS COUNTY: June 4, 1930, J. S. Hine, 1♀.

OKLAHOMA.—ARDMORE: June 8, 1939, Kaiser & Nailon, 1♀. BROKEN BOW: June 13, 1939, Kaiser & Nailon, 1♂, 1♀.

TENNESSEE.—SPARTA: May 31, 1934, T. H. Frison, 1♀.

Acroneuria filicis new species

In my paper on the stoneflies of Illinois (1935*a*), I commented at some length regarding the confusion in literature and determinations of species under the name *pennsylvanica* (Rambur). Ricker (1938) gives considerable information regarding specimens determined by Klapálek as *pennsylvanica*, and one of the specimens he studied at Prague may be the missing type of *pennsylvanica*. Ricker comes to the conclusion that *pennsylvanica* (Rambur 1842) is identical with *arenosa* (Pictet 1841) [not *clara* Klapálek (1917) = *arenosa* sense of Klápalek (1909)]. Accepting the synonymy indicated by Ricker, and I know of no valid reason to oppose his conclusion in this particular case, leaves an eastern North American species sometimes determined as *pennsylvanica* (Needham & Claassen 1922, 1925, at least in part) without a specific name.

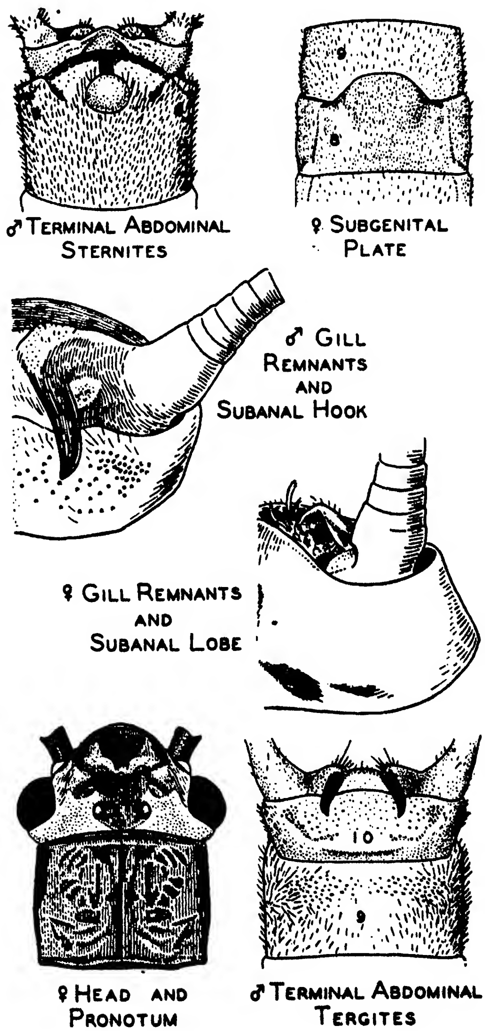


Fig. 41.—*Acroneuria filicis.*

Since the records and descriptions in existing literature in most, if not all, cases represent mixed series when *pennsylvanica* is referred to, I believe the best interests of nomenclature and taxonomy in this instance are served by considering the species of *Acroneuria* involved as a new species and by not merely proposing a new name.

Male.—General habitus the same as for other species of *Acroneuria* from North America. Dorsum of head yellow with a pattern of dark brown markings as in fig. 41. Pronotum brown with raised rugosities and a longitudinal, median depressed line, this line not lighter colored as in some other species. Terminal abdominal tergites with groups or patches of small spinulae arranged as in fig. 41. Genital hooks or modified subanal lobes tapering to a point and slightly curved inwards at tip. Subanal lobes show gill remnants.

Female.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite modified into a subgenital plate slightly extending over ninth sternite and with posterior margin rounded as in fig. 41.

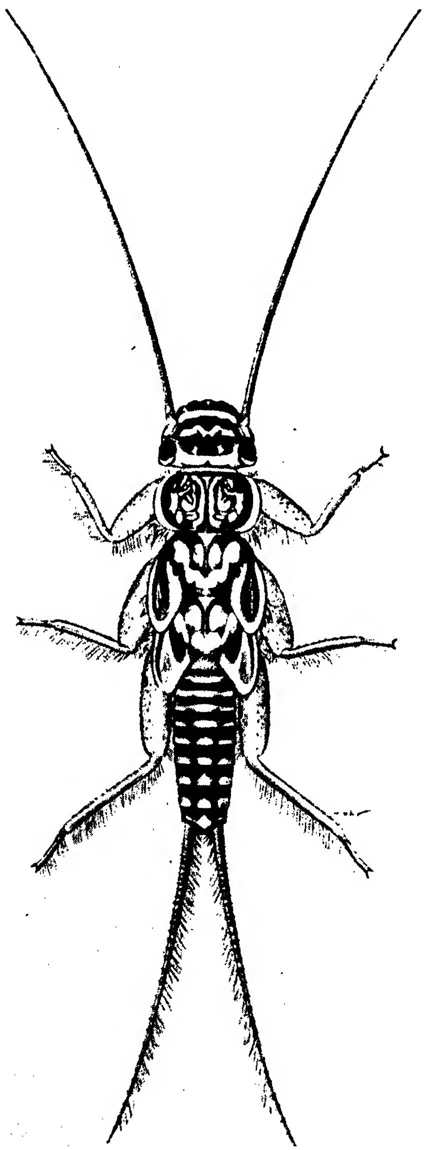


Fig. 42.—Nymph of *Acroneuria filicis.*

Holotype, female.—Pineville, Ky.: at light, June 24, 1938, T. H. Frison & T. H. Frison, Jr.

Allotype, male.—Same data as for holotype.

Paratypes. — Kentucky.—Pineville: Same data as for holotype and allotype, 12♂, 46♀. Cumberland Falls: June 12, 1940, T. H. Frison *et al.*, 1♀.

Tennessee. — Chimneys Camp Grounds, Great Smoky Mountains National Park, 2,900 feet elevation: Aug. 4, 1939, Rehn & Rehn, 2♂, 3♀; July 9, 1939, at light, A. C. Cole, 2♀; July 12, 1939, A. C. Cole, 2♀. Gatlinburg: June 18, 1940, reared from nymph, T. H. Frison *et al.*, 1♂.

Ohio.—Athens or Athens County: April 25, 1931, W. C. Stehr, 1♀; June 14, 1938, W. C. Stehr, 1♂; June 11–27, 1939, W. C. Stehr, 2♂, 4♀; June 20–22, 1941, W. C. Stehr, 5♂, 2♀; June 21–July 6, 1941, at light, J. Walker, 4♀.

I am naming this new species in honor of my son, T. H. Frison, Jr., who has accompanied me on many collecting trips for aquatic insects in various parts of the country and who assisted me in the collection of the material from Pineville.

Nymph.—A brief description of the more important characters of the heretofore unknown nymph is as follows: Body and appendages pale yellowish brown with a very distinct pattern of dark brown or dusky markings on dorsum, fig. 42; W-shaped, pale yellowish mark anterior to median ocellus is broad throughout and dark pattern tends to fill space between lateral ocelli and inner margins of compound eyes; abdominal tergites dominantly dark brown or dusky with pale yellowish on posterior margins, the yellowish part expanding along median line and on some segments tending to be segregated to

three spots on posterior margin. Head without a transverse occipital ridge on posterior margin between compound eyes.

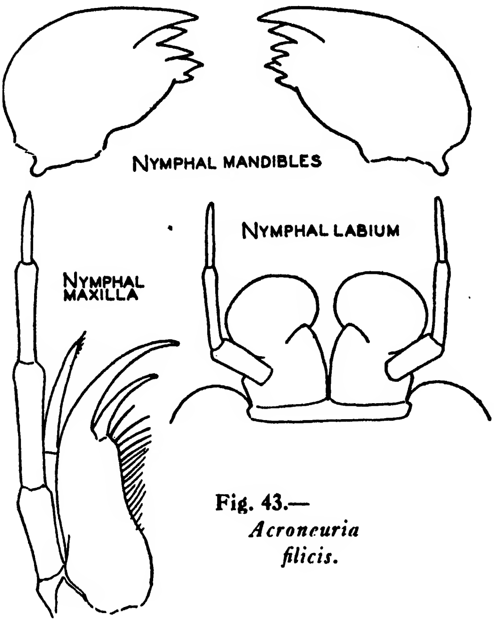


Fig. 43.—*Acroneuria filicis.*

Maxilla, labium and mandibles as in fig. 43. Anal gills present at apex of abdomen. Approximately full grown female nymph 25 mm. and male somewhat smaller.

This nymph in general resembles the nymphs of *evoluta* Klapálek (= *arida* of Frison 1935*a*), *perplexa* Frison and *mela* Frison, having in common with them anal gills. Differences in color pattern which seem to have taxonomic significance are as follows: (1) In *evoluta* (Frison 1935*a*, fig. 313) the pale yellow color of the head behind the ocelli tends to invade the space between the ocelli and compound eyes; the transverse dark bands of the abdominal tergites are usually confined to the anterior half of each tergite; and the transverse band on head anterior to median ocellus is more bandlike and less W-shaped. (2) In *mela* (Frison 1935*a*, fig. 316) the abdominal tergites are almost entirely dark, and three light spots, instead of a W-shaped transverse band, are present on the head anterior to the median ocellus. (3) In *perplexa* (Frison 1937, fig. 66) the dark markings on the abdominal tergites are mostly on the anterior half of each tergite and decrease in width near lateral margins, and the W-shaped mark on the head is less broad throughout.

Nymphal and exuvial records are as follows.

NORTH CAROLINA.—East fork of Tuckaseegee River, JACKSON COUNTY: June 19, 1939, T. Howell, 1 nymph. BLOWING ROCK MOUNTAIN: March 23, 1940, T. H. Frison, C. O. Mohr & A. S. Hawkins, 1 nymph.

TENNESSEE.—OZONE: June 11, 1935, H. H. Ross, 1 exuvia. GATLINBURG, Le Conte Creek: June 13, 1938, T. H. Frison & T. H. Frison, Jr., 2 nymphs; June 18, 1938, T. H. Frison & T. H. Frison, Jr., 1 exuvia; June 14, 1940, T. H. Frison *et al.*, 2 exuviae (adult ♂ reared from 1 exuvia).

Acroneuria xanthenes (Newman)

Perla xanthenes Newman (1838*a*, p. 178). Original description, ♂, ♀.

Acroneuria brevicauda Klapálek (1909, p. 245). Original description, ♂ (at least in part). Synonym.

Acroneuria xanthenes Needham & Claassen (1925, p. 194). Female suggested as type without definite lectotypic designation.

Acroneuria xanthenes Ricker (1938, p. 140). Accepts female as lectotype and erroneously records typic male as *Togoperla kansensis* (Banks).

Eccoptura xanthenes Klapálek (1923*a*, p. 63). Notes on types.

Although few records have been given for this species in literature, it has acquired a rather snarled and complicated bibliography. It is clearly evident from Klapálek's (1923*a*) illustrations of the two specimens, male and female, in the British Museum, accepted as the types, and Ricker's (1938) notes, that the male and female of the typic series represent two different species. This fact was first pointed out by Needham & Claassen (1925), and they suggested that the female be considered as the type because of its unique character, and that less confusion would then result. Ricker (1938) considers that Needham & Claassen (1925) designated the female as a "lectotype," but since no definite designation of a single type was made in this connection by Needham & Claassen, I herewith definitely designate the female of Newman's typic series of a male and female as the **lectotype**, and I select the female for the same reasons as those advanced by Needham & Claassen.

Ricker (1938) makes the additional statement that "Dr. Claassen identified the ♂ as *Togoperla kansensis* Banks." I cannot accept this placement of the typic male because Klapálek (1923*a*) clearly recognized *kansensis* as a distinct species, gave figures of *kansensis* which differ radically from the typic male he figured as

xanthenes, and erected a separate genus called *Banksiella* for the reception of the single species, *kansensis*. Since Klapálek stated he saw the typic male and female of *xanthenes*, and figured them as well as *kansensis*, I do not believe he could have failed to observe that the typic male of *xanthenes* was the same as *kansensis*, if such were the case. It is, however, certain from Klapálek's figure of the male which he accepted as *xanthenes* that this male is not the male of *xanthenes*, as Needham & Claassen state, and that it is not an *Acroneuria* as used in the sense of Needham & Claassen and all later North American students of this group. At the present time, unfortunately, I am unable to assign to any North American species the male figured and considered by Klapálek to be one of Newman's two typic specimens of *xanthenes*. Klapálek states that the two types are from "Georgia," but Newman did not indicate the locality in his original description, as he did with other new species described in the same article, and he did not insert the locality in his only other reference to *xanthenes* in 1839. Ricker (1938) repeats the statement that the male and female cotypes are "from Georgia" and evidently this locality record is now associated with the types.

Another annoying item in the bibliography and synonymy of *xanthenes* is the placement of *brevicauda*. The original description is based upon "1 ♂ N. Carol. Morr. (Coll. de Selys)," and, judged by Klapálek's remarks concerning color—no good structural details are given or figured—this specimen is the male of *xanthenes*. Ricker (1938) states that the "type" is in the Prague Museum (the Selys Longchamps collection is, or was, in Brussels) and resembles a small "♂ *A. arida* Hagen" and that a "paratype ('Cotypus') is a ♂ *A. xanthenes*" and that both are labeled "North Carolina, Morrison." If the type now is in the Prague Museum, the second specimen has been added to the typic series since the original description. Apparently, in any case, *brevicauda* falls into synonymy since the original description indicates a single specimen of *xanthenes*, and at least one of the specimens purporting to belong to the typic series of *brevicauda* at Prague is *xanthenes*. In case there are two typic specimens of *brevicauda* at Prague, as Ricker states, and there is no single type in the Selys collection at Brussels as Klapálek states, I herewith designate the male specimen at Prague stated by Ricker to be *xanthenes* as the **lectotype** of *brevicauda*. This procedure will insure the future placement of *brevicauda* in the synonymy of *xanthenes*, where the original description indicates it belongs.

Arrangements made with the officials of the Great Smoky Mountains National Park, Gatlinburg, Tenn., in 1940, enabled me to rear adult male and female specimens of *xanthenes* from nymphs and thereby confirm an association of adults and nymphs which, as a result of repeated Illinois Natural History Survey collecting trips to this region, had seemed evident for some time. Besides establishing the correct association of nymphs with adults, these rearings definitely proved the associ-

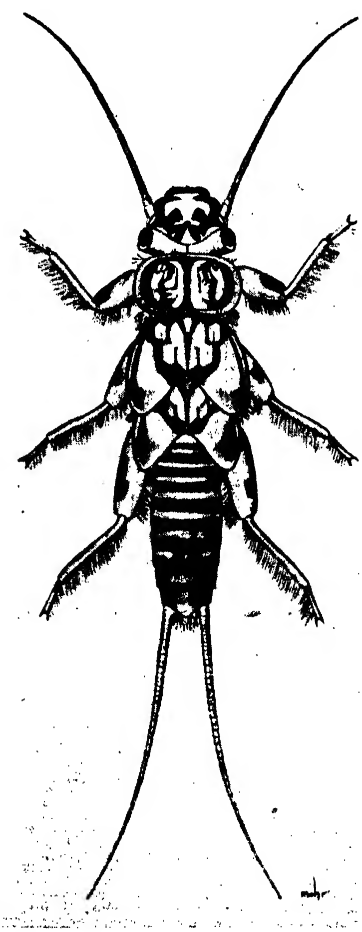


Fig. 44.—Nymph of *Acroneuria xanthenes*.

ation of males with females as given by Needham & Claassen (1925).

NYMPH.—A brief description of the important characters of the nymph is as follows: General morphological features similar to those of other described nymphs

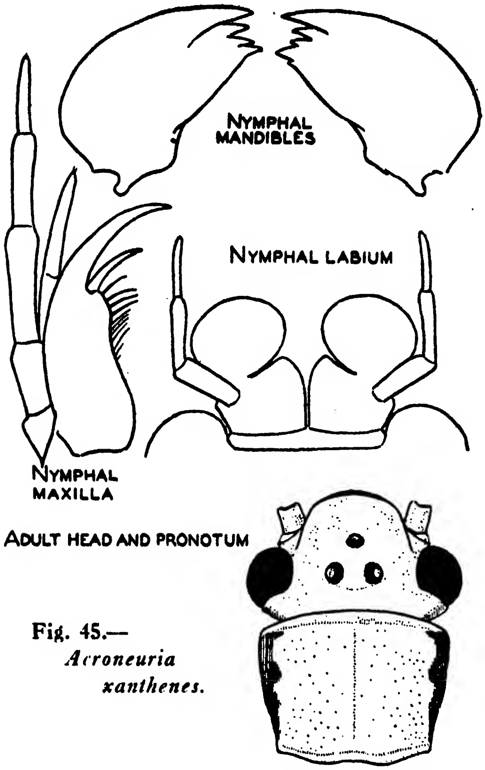


Fig. 45.—*Acroneuria xanthenes.*

of *Acroneuria* (Frison 1935*a*). Body and appendages yellow with a very distinctive pattern of dark brown or dusky markings on dorsum, fig. 44; large open area anterior to ocelli is particularly distinctive; dorsal abdominal tergites with narrow, dark, transverse bands on anterior and posterior margins, these bands usually becoming fused in part on apical segments. Head without a transverse occipital ridge on posterior margin between compound eyes. Maxilla, labium and mandibles as in fig. 45. Anal gills present at apex of abdomen. Approximately full grown nymph with a length of 20 mm.

The most important structural characters of the adult do not need to be redescribed since the female subgenital plate has been well illustrated by Klapálek (1923*a*) and Needham & Claassen (1925), and the male by the latter authors. To aid with its determination, I now add an illustration, fig. 45, showing the dorsal color pattern of the head and pronotum. This pattern is especially distinctive among *Acroneuria* because of the dusky lateral margins on the pronotum. In fresh material, these margins contrast with the rest of the surface, which is entirely yellow or yellowish, except for black ocelli and compound eyes.

Acroneuria xanthenes has been previously recorded only from Georgia and North Carolina. Supplementary and new state distributional records are as follows.

FLORIDA.—LIBERTY COUNTY: Camp Torreya, April 12, 1930, 5 nymphs; Torreya State Park, Dec. 10, 1937, L. Berner, 4 nymphs.

GEORGIA.—ATLANTA: May 30, 1937, P. W. Fattig, 1♂. Jones County, 10 miles north of MACON: April 30, 1938, L. Berner, 1 nymph.

NORTH CAROLINA. — MONTREAT, Orlando Park: June 21, 1929, 1♂. CHEROKEE: June 26, 1938, W. Stehr, 1♂. MARION: April 24, 1938, Ross & Burks, 1 nymph. SMOKEMONT: June 14, 1935, H. H. Ross, 2 exuviae. JACKSON COUNTY: Chattooga River, Aug. 28, 1938, T. Howell, 1 nymph; Norton Mill Creek, Aug. 8, 1938, T. Howell, 1 nymph. HOT SPRINGS, French Broad River: June 15, 1935, H. H. Ross, 1 exuvia. NEWFOUND GAP, 2,560 feet elevation: May 28, 1934, T. H. Frison, 2 nymphs. MACON COUNTY: Edward's Creek, Aug. 26, 1938, T. Howell, 1 nymph; Nantahala River, May 30, 1939, T. Howell, 1 nymph. SWAIN COUNTY, Smoky Park, Forney Creek: Aug. 13, 1939, T. Howell, 1 nymph. JACKSON COUNTY: east fork of Tuckaseegee River, June 13, 1939, T. Howell, 4 nymphs; Slicken Creek, June 14, 1939, T. Howell, 2 nymphs; Knob Creek, July 20, 1939, T. Howell, 1 nymph; west fork of Tuckaseegee River, July 20, 1939, 1 nymph.

OHIO.—Waterloo Township, ATHENS COUNTY, branch of Grass Run: May 15, 1941, J. D. Walker, 3 nymphs.

PENNSYLVANIA.—JENKINTOWN, Montgomery County: Aug. 15, 1939, A. M. Laessle, 1 nymph.

TENNESSEE.—GREAT SMOKY MOUNTAINS NATIONAL PARK: Grassy Patch, July 22, 1939, A. C. Cole, 7♀; Chimneys Camp Grounds, July 12, 1939, A. C. Cole, 1♂, 6♀; Chimneys Camp Grounds, at light, July 16, 1939, A. C. Cole, 2♂, 10♀; Chimneys Camp Grounds, July 20–24, 1939, A. C. Cole, 5♀; Chimneys Camp Grounds, at light, July 3–9, 1939, A. C. Cole, 10♀; Chimneys Camp Grounds, 2,700 feet, June 17, 1939, A. C. Cole, 1♂; Greenbrier Cove, 2,400 feet, July 19, 1939, A. C. Cole, 1♀. SMOKY MOUNTAINS: June–July, 1940, A. C. Cole, 1♀. ELKMONT, Little River: June 17, 1938, T. H. Frison & T. H. Frison, Jr., 4 exuviae. OZONE: June 11, 1935, H. H. Ross, 2 exuviae. GATLINBURG: June 15, 1940, T. H. Frison *et al.*, 1♀, exuvia (reared); Fighting Creek (branch of Little Pigeon River), May 27, 1934, T. H. Frison, 4 nymphs; Le Conte Creek, June 13, 1938, T. H. Frison & T. H. Frison, Jr., 1 exuvia; Le Conte Creek, June 16, 1938, T. H. Frison & T. H. Frison, Jr.,

1 nymph, 6 exuviae; Pigeon River, June 14, 1940, Frison *et al.*, 6 nymphs, 1 exuvia; June 16–17, 1940, Frison *et al.*, 2♂, exuviae (reared); June 20, 1940, Frison *et al.*, 1♀, exuvia (reared); June 27, 1940, Frison *et al.*, 1♀, exuvia (reared); Le Conte Creek, June 14, 1940, Frison *et al.*, 4 exuviae; Little Pigeon River, June 12, 1935, H. H. Ross, 9 nymphs.

VIRGINIA. — CURLEY'S NECK BRIDGE: April 19, 1938, M. E. Davis & D. T. Ries, 1 nymph. GREAT FALLS: April 3, 1938, B. D. Burks, 1 nymph. BIG MEADOWS, Skyline Drive: Jan. 1, 1939, Frison & Burks, 1 nymph. CRIGLERSVILLE, Rapidan River: March 27, 1938, B. D. Burks, 1 nymph. FAIRFAX: Dec. 31, 1938, Frison & Burks, 5 nymphs. MADISON, Crooked Run Creek: Jan. 1, 1939, Frison & Burks, 13 nymphs. SPEEDWELL: March 22, 1940, Frison, Mohr & Hawkins, 1 nymph. FALLS CHURCH: June 11, 1♀ (collection of N. Banks); April 2, 1941, B. D. Burks, 1 nymph.

Acroneuria georgiana (Banks)

Perla georgiana Banks (1914, p. 608). Original description, ♀.

Since this species was first described from a single female from Clayton, Ga., June, 1909, Type No. 11,328, Museum of Comparative Zoology, it has been recorded again only from "Tallulah Falls, June 17, Georgia," and from "North Carolina," both records by Needham & Claassen (1925).

Illinois Natural History Survey field work in the Great Smoky Mountains National Park over a period of years revealed the presence there of a small *Acroneuria* nymph which was suspected of being the nymph of *georgiana*. In 1940, male adults of *georgiana* were reared from this nymph, thereby definitely establishing this relationship.

Since the nymph has not been previously recognized, a brief description of its most important characters is given here. General morphological features similar to other described nymphs of *Acroneuria* (Frison 1935*a*). Body and appendages mostly uniformly yellowish brown, without a prominent, contrasting, dusky or dark color pattern, except on dorsum of head, fig. 46. Head with a distinct transverse occipital ridge on posterior margin between compound eyes. Maxilla, labium and mandibles as in fig. 47. Anal gills present at apex of abdomen. Approximately full grown nymph with length of 15 mm.

Needham & Claassen (1925) have figured the most important characters of the male and female. It should be added to their description that in fresh material the adult males are very pale colored and the dark brown or dusky markings on the dorsum of the head form a very distinctive pattern, fig. 47.

Records for this species in the collection of the Illinois Natural History Survey are as follows.

NORTH CAROLINA. — SMOKEMONT: June 14, 1935, H. H. Ross, 1 nymph. RAINBOW GAP: April 24, 1938, H. H. Ross & B. D. Burks, 1 nymph. MONTREAT, Lookout Cove: July 2, 1928, O. Park, 6♂. Graybeard Mountain near MONTREAT, west fork of Flat Creek Cove: July 7, 1928, O. Park, 1♂.

TENNESSEE.—GATLINBURG: June 17 and 26, 1940, T. H. Frison *et al.*, 2♂, reared; Fighting Creek Gap, May 15, 1939, T. H. Frison

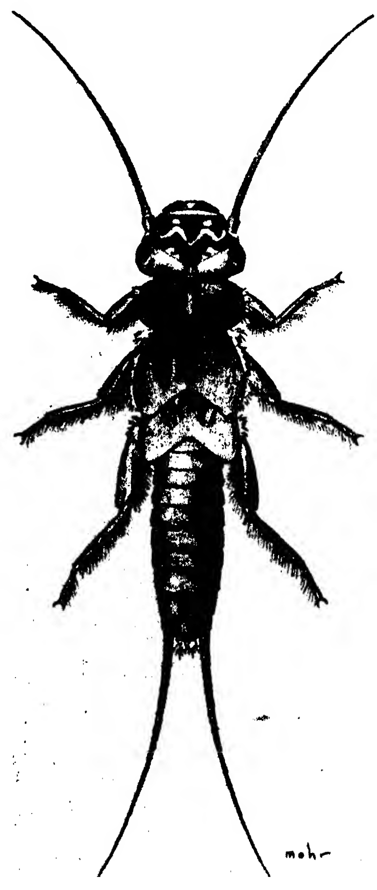


Fig. 46.—Nymph of *Acroneuria georgiana*.

& H. H. Ross, 2 nymphs; Fighting Creek Gap, May 27, 1934, T. H. Frison, 6 nymphs; Little Pigeon River near Alum Cave Trail, June 17, 1938, T. H. Frison & T. H. Frison, Jr., 1 nymph; Le Conte Creek, June 18, 1938, 5

exuviae, and June 16, 1938, 1 nymph, T. H. Frison & T. H. Frison, Jr.; Little Pigeon River, June 17, 1938, T. H. Frison & T. H. Frison, Jr., 1 nymph. MARYVILLE: May, 1923, 4 nymphs. ELKMONT, Little River: June 17, 1938, T. H. Frison & T. H. Frison, Jr., 1 nymph, 3 exuviae. GREAT SMOKY MOUNTAINS NATIONAL PARK, Chimneys Camp Grounds: July 3–9, 1939, A. C. Cole, 1 ♂.

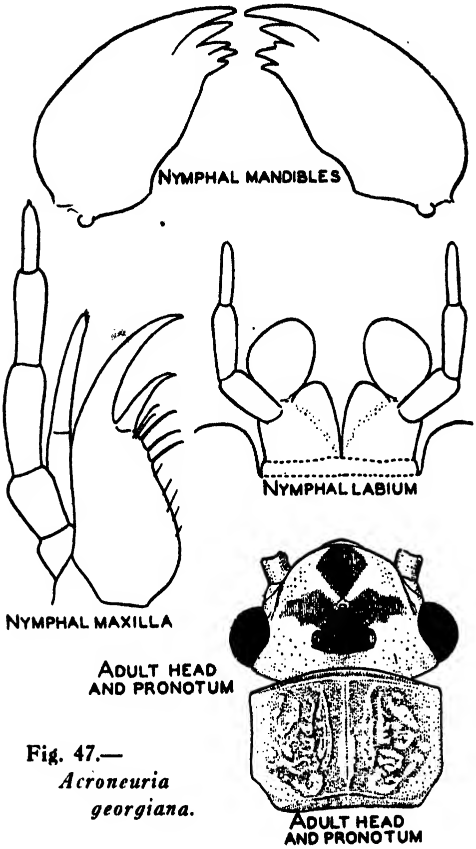


Fig. 47.—*Acroneuria georgiana.*

Acroneuria carolinensis (Banks)

Perla carolinensis Banks (1905, p. 215). Original description, ♂, ♀.

Acroneuria lycorias Claassen (1931, p. 87). Nymph—new synonymy.

Acroneuria lycorias Frison (1937, p. 97). Erroneous synonymy of *cuestae* Ricker.

This is another species of *Acroneuria* which has been infrequently recorded in literature and confused with other species. Reared specimens of both *carolinensis* and *lycorias* (Newman) prove that Claassen (1931) erroneously associated the nymph of *carolinensis* with the species *lycorias* and failed to recognize the nymph of *lycorias* (= *perbranchiata* Neave).

Illinois Natural History Survey rearings and collections in various states where both *carolinensis* and *lycorias* occur have led to the discovery that the nymphs of the former have no anal abdominal gills, whereas such gills are present in *lycorias*. A corollary of this, of course, is that the subanal lobes of the adults in both sexes in *lycorias* possess anal gill remnants, whereas these remnants are lacking in *carolinensis*. Such an easily observed character as the presence or absence of anal gills or gill remnants is most important and useful when dealing with two species which look so much alike.

In 1937, I placed *cuestae* Ricker (1935*b*) in the synonymy of *lycorias*. This placement was in error and resulted from the erroneous identification of reared male and female specimens from New York, sent to me by Dr. P. W. Claassen as *lycorias*, and their association with exuviae which Dr. Claassen figured (1931) as *lycorias*. These adults, however, are without question *carolinensis* and are properly associated with exuviae without anal gill remnants. Correctness of this association of nymphs with adults is confirmed by rearing of an adult male of

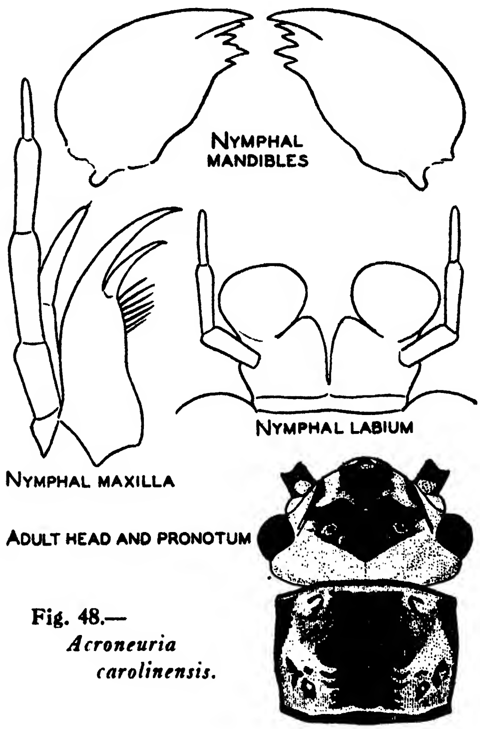


Fig. 48.—*Acroneuria carolinensis.*

carolinensis from a nymph at Gatlinburg, Tenn., and the collection of a series of nymphs and adults from the Smoky

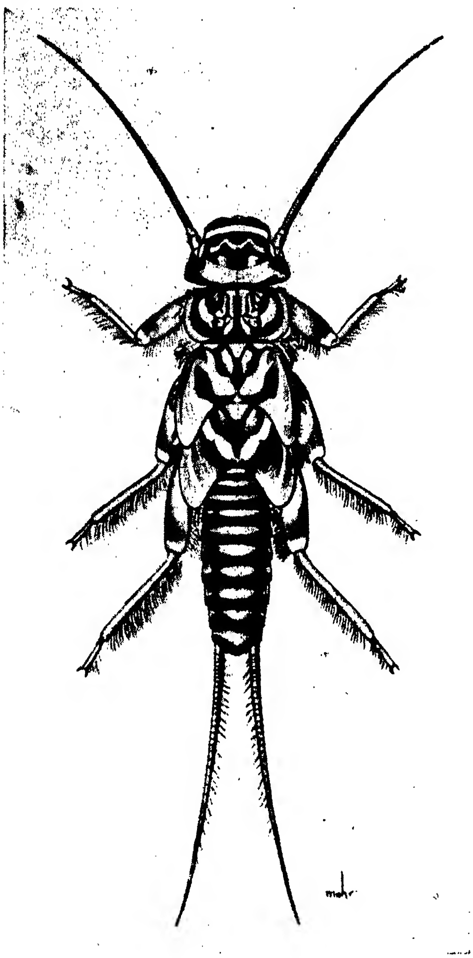


Fig. 49.—Nymph of *Acroneuria carolinensis.*

Mountains region, the adults of which agree perfectly with the types in the Museum of Comparative Zoology.

Because of a lack in the past of definite tangible characters for the separation of *lycorias* and *carolinensis*, the latter has appeared in literature as a species with a very restricted distribution. It is very probable that some of the adult records given by Needham & Claassen for *lycorias* apply to *carolinensis*, since Illinois Natural History Survey material shows *carolinensis* to be present in several of the states of the Appalachian region. Since the head pattern of *Acroneuria* adults, within certain limits, has some value when making determinations, an illustration of it is given, fig. 48, to compare with similar illustrations which I have given for other species of the same genus.

NYMPH.—Although Claassen (1931) has given a photographic illustration of the nymph of *carolinensis*, under the name of *lycorias*, I think it highly desirable to include here the reproduction of a drawing of the nymph. A brief description of the nymph is as follows: General color of body and appendages yellow with brown or dark markings as in fig. 49; particularly important features of the color pattern are the arrangement of the light and dark areas on the dorsum of the head and the banding of the abdominal tergites; in color pattern the nymph is very similar to *lycorias*, but it differs from the nymph of *lycorias* in the lack of anal abdominal gills. No occipital transverse ridge on the posterior part of the head. Maxilla, labium and mandibles as in fig. 48.

The typic series of *carolinensis* consists of two females and one male, No. 11,320, from the "Black Mts. VI N.C." in the collection of the Museum of Comparative Zoology. Specimens in the Illinois Natural History Survey collection have been compared with these types. Through the kindness of Dr. Nathan Banks, I was permitted to clip off the apical abdominal segments of one of the typic females, relax it and study it in fluid, a procedure which enabled me to establish that these typic pinned specimens did not possess anal gill remnants on the subanal lobes.

It should be mentioned, at this time, that I believe *Perla lurida* Hagen (1861) is the same species as *carolinensis*, but hesitate to place *carolinensis* definitely as a synonym of *lurida*, which would have priority, until more information is available about the *Acroneuria* fauna of Georgia, Alabama and Louisiana. The type of *lurida* is a female, No. 246, in the collection of the Museum of Comparative Zoology, and bears the data "N. Orleans Pfeiffer 1858," which agree with statements in the original description. The apical abdominal segments of this type, by permission of Dr. Banks, were clipped off, softened in potassium hydroxide, and studied in fluid. The subgenital plate seems to be almost identical with that of *carolinensis*, and the lack of any anal gill remnants on the subanal lobes is a further

very convincing bit of evidence that the two are identical.

Since the distributional pattern of *carolinensis* is so poorly known, the following records, based upon the Illinois Natural History Survey collection and an examination of material sent for study, are presented.

MARYLAND.—KEYSER RIDGE: Dec. 30, 1934, Frison & Ross, 2 nymphs.

NEW HAMPSHIRE.—NORTH WOODSTOCK, Bog Brook: June 21, 1941, Frison & Ross, 1 nymph.

NEW YORK.—Lloyd Cornell Wild Flower Preserve, CAROLINE: Aug. 16, 1928, T. H. Frison, 1 nymph. ITHACA: Sept 4, 1936, Harvey Bowman, 39 nymphs; Coy Glen, under stones and in gravel of rapid waters, Oct. 6, 198 [1908?], nymphs. DOWNSVILLE: Campbell Brook, Sept. 4, 1935, nymphs; June 16, 1940, H. Dietrich, 1♂. MCLEAN: May 29, 1927, 1♂, 1 exuvia. Wild Life Preserve, SISTERVILLE: June 9, 1927, 1♀, 1 exuvia. SCHOHARIE: June 6, 1937, Flick, 1♀; May 14, 1938, P. Jennings, 1 nymph. KEENE, small creek 3 miles west, Adirondack State Park: June 20, 1941, Frison & Ross, 1 exuvia. EUBA MILLS, Adirondack State Park: June 20, 1941, Frison & Ross, 1 exuvia. ROSCOE, Beaver Kill Creek: June 28, 1940, P. Jennings, 1♂. MOUNT TREMPER, Esopus Creek: July 31, 1938, P. Jennings, 1♀. BEAVER KILL, Beaver Kill River: July 24, 1940, R. B. Fischer, 1 nymph. UPPER BEAVER KILL: June 21, 1936, Nottingham, 1 nymph. CATSKILL: June 20, 1936, J. B. N., 4 nymphs.

NORTH CAROLINA.—BLACK MOUNTAIN, fork north of Swannanoa: May, 1♂; VI, 2♀.

PENNSYLVANIA.—POYNTELLE: June 17, 1904, M. Hebard, ♂. MONROE COUNTY: Marshall's Creek, May 24, 1935, W. J. Harmer, 3 nymphs; Saw Creek, May 19, 1935, W. J. Harmer, 3 nymphs. PIKE COUNTY, Saw Creek: May 19, 1935, W. J. Harmer, 6 nymphs.

TENNESSEE.—GATLINBURG: Le Conte Creek, May 14, 1939, Frison & Ross, 1 exuvia; May 14, 1939, Frison & Ross, 1♂ (reared); June 13, 1940, Frison *et al.*, many exuviae; June 14, 1940, Frison *et al.*, 1♂, 35♀, 1 exuvia; June 14, 1940, T. H. Frison, 1 adult. KNOXVILLE: June 13, 1940, Frison *et al.*, many exuviae; June 14, 1940, Frison *et al.*, 1 exuvia.

VIRGINIA—STANDARDSVILLE: Sept. 27, 1936, Frison, 1 nymph.

Acroneuria lycorias (Newman)

Perla lycorias Newman (1839, p. 35). Original description.

Acroneuria lycorias Ricker (1938, p. 139). Designates lectotypic ♀.

Acroneuria perbranchiata Neave (1933, p. 237). New synonymy.

Newman in his original description does not give the sex of his typic specimens, but Ricker (1938) designates a female specimen in the Hope Collection, University Museum, Oxford, as the lectotype and states that it agrees with Needham & Claassen's (1925) description of this species. Elsewhere in this article I have pointed out that there has been some mixing of species under the name of *lycorias* and that the nymph described as this species by Claassen (1931) is the nymph of *carolinensis* (Banks).

A study of paratypic male and female specimens of *Acroneuria perbranchiata* Neave sent to the Illinois Natural History Survey collection by Neave has revealed that this species is a synonym of *lycorias*. I suspect that Claassen's (1931) erroneous assignment of the nymph of *carolinensis* to *lycorias* had some influence in leading to the description of *perbranchiata* since Neave describes the nymph of *perbranchiata* and mentions its great similarity with *lycorias* as described by Claassen except for the presence in *perbranchiata* of anal abdominal gills.

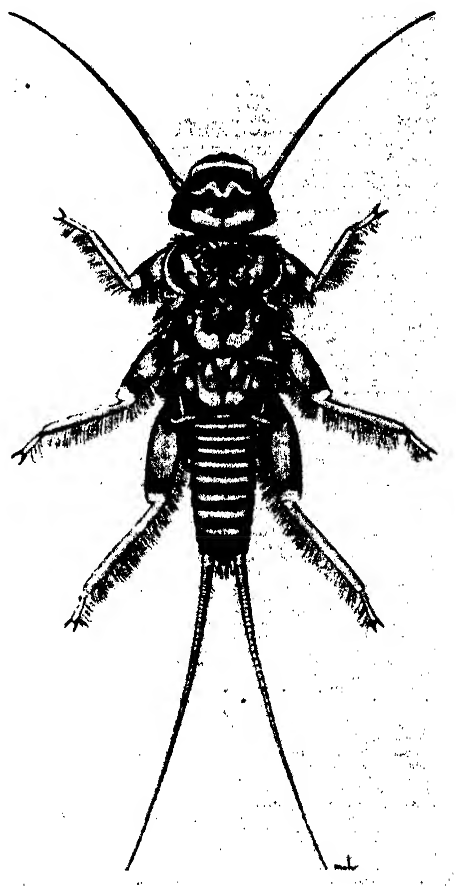


Fig. 50.—Nymph of *Acroneuria lycorias*.

Neave's (1933) description of the nymph of *perbranchiata* is a very good one and since it is identical with *lycorias* there is little need here for many further remarks. Neave did not figure the nymph,

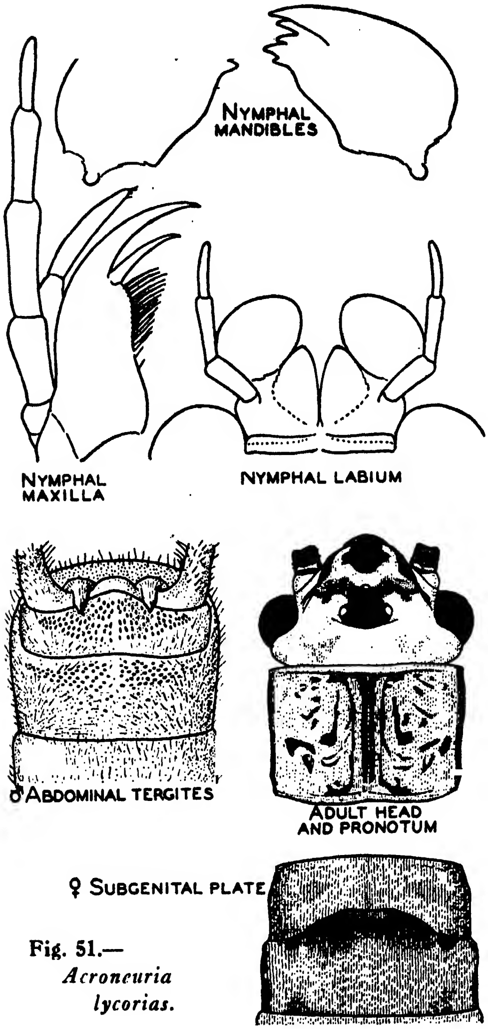


Fig. 51.—*Acroneuria lycorias.*

however, and since Claassen's figure is in error as to species I believe it well to include here an illustration of the nymph. The most important features of this nymph are the color pattern, fig. 50, and the presence of the anal abdominal gills. The maxilla, labium and mandibles are as in fig. 51.

Since the adults of *lycorias* have been confused with those of other species, I am presenting here illustrations of the color pattern of the dorsum of head and pronotum, fig. 51, the subgenital plate of the female, fig. 51, and the dorsal apical segments of the male, all based upon reared material. Klapálek's (1909) figure of the subgenital plate of the female of *lycorias* does not agree with my figure, but Ricker has fixed a lectotype for *lycorias* which is similar to the illustration of Needham & Claassen (1925) and this is comparable to my material. Very likely Klapálek's material, at least in part, represents some other species.

In addition to reared male and female specimens obtained on Illinois Natural History Survey field trips to Michigan, Tennessee and Wisconsin, I have studied reared material from Minnesota sent to me for identification. A large series of adults and nymphs of this species in the Survey collection are from Florida, Maine, Manitoba, Maryland, Massachusetts, Michigan, Minnesota, New York, Ohio, Ontario, Pennsylvania, Tennessee and Wisconsin.

Acroneuria theodora
Needham & Claassen

Acroneuria theodora Needham & Claassen (1922, p. 254). Original description, ♂, ♀.
Acroneuria theodora Claassen (1931, p. 90). Nymph.

This species has not been recorded in literature since its description, and because of its rarity the following notes, illustrations and records are presented.

The original description of the adults did not contain any illustrations of the structural features most important from the standpoint of identification. A few years later Needham & Claassen (1925) published line drawings of the apical segments of the male and the subgenital plate of the female. Since these drawings are not very detailed, I think it worthwhile to present new drawings of these structures and also some additional ones, fig. 52, which should aid with the future recognition of this western species.

Comparisons of Illinois Natural History Survey material of *theodora* with that of *californica* (Banks) have revealed that the aedeagus of *theodora* is very distinctive and differs markedly from that of *californica* and other species of *Acroneuria* studied. Like *californica*, *theodora* belongs with the series of *Acroneuria* which do not possess anal abdominal gills in the nymphs or gill remnants on the subanal lobes of the adults. *A. depressa* Needham & Claassen (1922) and *pacifica*

Banks have these anal gills in the nymphs or anal gill remnants in the adults.

Needham & Claassen in the original description state that the males of *theodora* are "brachyterous," but give measurements of "length to tip of wings" for the males as "29–32 mm.," and "expanse 48–50 mm." In their *Monograph* of a few years later, 1925, the "length to tip of wings" of the male is given as "15 mm.," and the "expanse—20 mm." Evidently the males vary from short-winged to long-winged forms. Two male specimens in the Illinois Natural History Survey collection from Wyoming have actual wing lengths of 15 and 20 mm., and male specimens from Oregon have wings as long as 28 mm. Wing lengths are poor criteria for separation of species in Plecoptera.

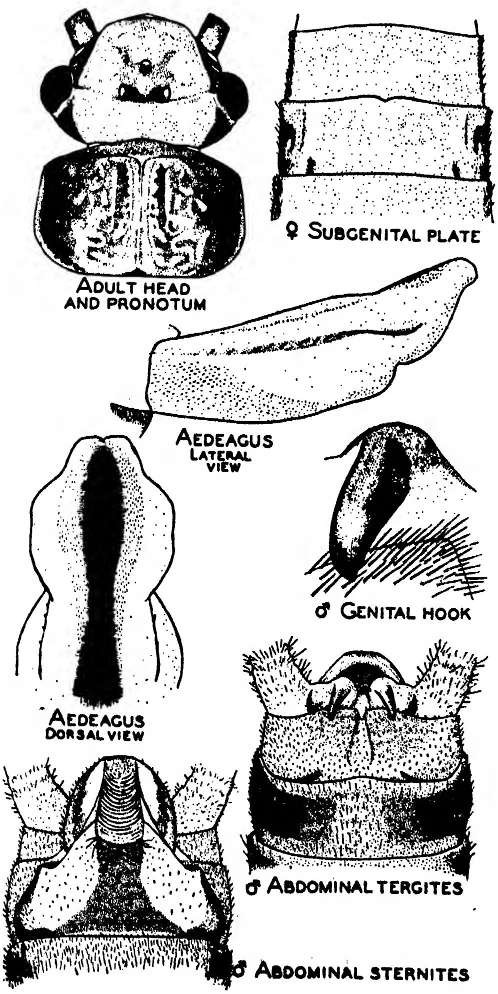


Fig. 52.—*Acroneuria theodora.*

Illinois Natural History Survey collection records for *theodora* are as follows.

CALIFORNIA.—MODOC COUNTY: July 20, 1922, 1♂.

OREGON.—MCKENZIE RIVER: south fork, 20 miles south from confluence, Sept. 4, 1932, R. Dimick, 1♂; Sept. 21, 1934, R. Dimick, 9♂, 8♀, 3♂ exuviae, 8♀ exuviae. Camp Creek, MOUNT HOOD NATIONAL FOREST: Aug. 2, 1933, R. Dimick, 1♀ nymph. MCKENZIE BRIDGE: Sept. 21, 1934, R. Dimick, 5♂, 5♀, 3♀ exuviae. East Fork River, WILLAMETTE NATIONAL FOREST: Sept. 6, 1936, V. E. Storr, 1♂. BOYER, foot-log on Salmon River: Sept. 22, 1935, J. A. Macnab, 1♂. MCMINNVILLE: Sept. 16, 1933, J. A. Macnab, 1♂. SUMMIT PRAIRIE, July 23, 1939, 1♂.

WYOMING.—Shell Exit, BIG HORN MOUNTAINS: July 30, 1940, T. H. F. & T. H. F., Jr., 1♂. Bondi Camp, BIG HORN NATIONAL FOREST, Tongue River: July 28, 1940, T. H. F. & T. H. F., Jr., 1♂.

Acroneuria sabulosa (Banks)

Perla sabulosa Banks (1900, p. 242). Original description, ♀.

Acroneuria depressa Needham & Claassen (1922, p. 253). Original description, ♂, ♀. New synonymy.

Perla sabulosa Needham & Claassen 1925, p. 101). New synonymy.

By permission of Dr. Nathan Banks, I have had the privilege of studying critically the typic female, No. 11,317, of *sabulosa* and the holotype and allotype, No. 15,520, of *depressa* in the collection of the Museum of Comparative Zoology.

In order to study the typic female of *sabulosa* and a paratypic female of *depressa* in fluid, I relaxed the specimens and slightly softened the apical abdominal segments with potassium hydroxide. Both were found to be a species of *Acroneuria* which reveal traces or remnants of gills on the subanal lobes and hence must have nymphs with anal gills. No tangible differences were found to exist between the specimens; therefore, and because of priority of description, the specific name of *depressa* must fall into the synonymy of *sabulosa*.

It is interesting to note that the typic specimen of *sabulosa* came from "Yakima, Wash.," and the typic series of *depressa* came from "Yakima River, Lone Tree, June 30, '82, W. T. [= Wash.]."

Under *Claassenia arctica* (Klapálek) in this article I have pointed out that Claassen (1931) erroneously described and illustrated the nymph of *arctica* under the name of *Acroneuria depressa*. The nymph

of *sabulosa* (= *depressa*) still remains to be discovered, but when found will possess anal abdominal gills.

Claassenia arctica (Klapálek)

Adelungia arctica Klapálek (1916, pp. 59, 78). Original description, ♂, ♀.
Perla languida Needham & Claassen (1925, p. 100). New synonymy.
Claassenia languida Ricker (1938, p. 140). Notes on type and generic transfer.
Acroneuria depressa (?) Claassen (1931, p. 86 and pl. 27, fig. 207). Misidentification of nymph.

This large western species of stonefly has had an interesting bibliographic history, considering the few times it has been mentioned in literature. It was originally described by Klapálek in his new genus *Adelungia*, with *caudata* from China as its genotype. In 1925, Needham & Claassen in their *Monograph* described *languida* from specimens from Wyoming and Montana, but strangely made no mention of a species *arctica* from "Arctic America." Wu (1934) noted that *Adelungia* was a preoccupied name and proposed *Claassenia* as the name to replace *Adelungia*, without any reference to its occurrence in North America. Ricker (1938) noted the close relationship between *arctica* and *languida* and placed both for the first time in the genus *Claassenia*. Ricker's figures of the typic specimens in the British Museum and studies of specimens in the Illinois Natural History Survey collection convinced me that *languida* is a synonym of *arctica*. Many species occurring in the mountains of northwestern states range far into Canada.

Whether the species now included in *Claassenia* form a sufficiently distinct group to warrant generic status may be questioned, but at least for the present I am so recognizing them.

In August, 1940, while in Yellowstone National Park, Wyo., I had an excellent opportunity to rear series of *arctica*, both male and female, from nymphs and observe some of the habits of the adults. The adults are nocturnal and emerge at nightfall from nymphs which crawl out of the water on rocks or other objects near the shoreline of such turbulent mountain streams as the Yellowstone River. During the day the adults rest under stones and other objects close to the water's edge and when active at dusk or night have the ability to advance rapidly over the surface of the water somewhat like water-striders. Mating often takes place as soon as the females emerge from nymphal skins, and the males are able to recognize nymphs destined to be females as proved by attempts at mating and by waiting for a particular female to emerge.

Claassen (1931) described and figured the nymph of *arctica* under the name of "*Acroneuria depressa* (?)." Certain characters of this nymph, particularly size, occipital ridge and anal gills, in addition to locality records, caused me to suspect its true identity before actually rearing it in 1940.

Since records of the occurrence of this species are few, and confined to the references

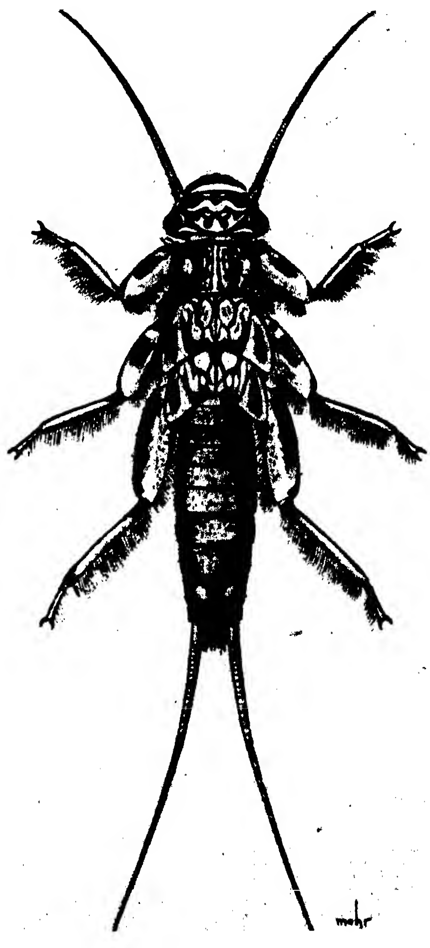


Fig. 53.—Nymph of *Claassenia arctica.*

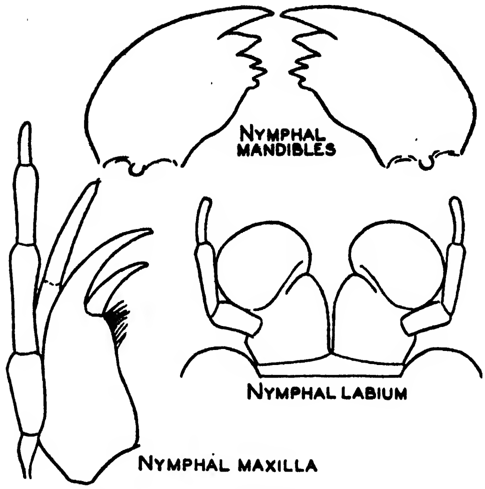


Fig. 54.—*Claassenia arctica.*

listed above, I present the following additional data from the Illinois Natural History Survey collection.

MONTANA.—VARNEY, Madison River: July 29, 1937, P. Jennings, 1 nymph. GLACIER NATIONAL PARK, Logging Creek: July 11, 1940, H. H. & J. A. Ross, 2 nymphs, 1 exuvia.

SOUTH DAKOTA.—SPEARFISH: July 25, 1924, 1♂; July 27, 1940, T. H. Frison & T. H. Frison, Jr., 3 exuviae.

WASHINGTON.—SEATTLE: C. V. Piper (collection of N. Banks), 1♂; Cedar River, April 1, 1939, L. Lambuth, 2 nymphs.

WYOMING. — YELLOWSTONE NATIONAL PARK, Gardiner River, Yellowstone River, Cascade Creek and Nez Perce Creek: July 30–Aug. 3, 1940, T. H. Frison & T. H. Frison, Jr., many nymphs, ♂♂, ♀♀. GRAND TETON NATIONAL PARK, Taggart Creek: Aug. 7, 1940, T. H. Frison & T. H. Frison, Jr., 3 nymphs, 1 exuvia. DANIEL, Green River: Aug. 13, 1940, T. H. Frison & T. H. Frison, Jr., 1 exuvia. MOOSE, Snake River: Aug. 6, 1940, T. H. Frison & T. H. Frison, Jr., 6 nymphs, 6 exuviae.

COLORADO.—IDA: June 19, 1934, 1♀. GUNNISON: July 3, 1934, 3♂. ESTES PARK, Big Thompson River: Aug. 4, 1940, T. H. Frison & T. H. Frison, Jr., 2 nymphs, 5 exuviae.

IDAHO.—Swan Valley, CARIBOU NATIONAL FOREST: Aug. 28, 1935, H. S. Telford, 1♀.

Although Claassen (1931) described and figured this nymph, but under the wrong name, it seems desirable here to present a new illustration of it, fig. 53, and add illustrations of the mouthparts, fig. 54.

PERLODIDAE

Perlodes Banks

It has been my good fortune to study in considerable detail the types, or what remains of them, of *Arcynopteryx vagans* Smith, *Arcynopteryx aurea* Smith, *Arcynopteryx lineata* Smith, *Protarcys bradleyi* Smith, *Protarcys dolobrata* Smith (the neallotype only), *Dictyopteryx irregularis* Banks, *Dictyopteryx signata* Hagen, *Perlodes slossonae* Banks, *Perlodes yosemite* Needham & Claassen (allotype) and *Perlodes tibialis* Banks. All of these species were placed by Needham & Claassen (1925) in the genus *Perlodes*, and while these authors sank *Protarcys* Klapálek, *Megarcys* Klapálek and *Arcynopteryx* Klapálek as synonyms of the subgenus *Perlodes*, they proposed the new subgenus *Perlinodes* for the reception of *Arcynopteryx vagans.*

I have studied too few specimens of adults and nymphs to permit me to come to definite conclusions regarding the proper appraisal of the names *Arcynopteryx*, *Megarcys*, *Protarcys*, *Perlinodes* and *Perlodes*. For the present, at least, it seems that the safest procedure is to follow Needham & Claassen (1925) in placing them all in the genus *Perlodes* and recognize as subgenera the other proposed units of classification above the rank of species in this family.

The studies have progressed far enough, however, to indicate that much synonymy exists in the genus and that fine distinctions of wing venation are not reliable for species determinations. One of the outstanding features of *Perlodes* (*s.l.*), as I recognize the genus, is the variety and character of gills. All species studied to date have the submental gills found in *Isogenus* and *Hydroperla*, and some species have additional pairs of gills in the cervical region and on the thorax. Needham (1933) has even described a new genus, *Oroperla*, with a new species called *barbara*, based upon the nymph, which has a row of gills on each side of the abdominal segments. The adult of *barbara*, when found, should show remnants of these gills.

My conclusions to date regarding valid species and synonymy are presented under the headings of the species concerned.

Perlodes minor (Klapálek)

Arcynopteryx minor Klapálek (1912, p. 22). Original description, ♂.

Perlodes slossonae Banks (1914, p. 608). Original description, ♀. New synonymy.

Arcynopteryx lineata Smith (1917, p. 476). Original description, ♀. New synonymy.

Perlodes margarita Alexander (1936, p. 26). Original description, ♂. New synonymy.

Apparently every time a specimen of this species has fallen into a collector's hand it eventually has formed the basis for a description of a new species. The synonymy I have indicated above is based upon a study of the holotypic female of *lineata* (C. U. No. 1,138) and the typic female of *slossonae* (M.C.Z. No. 11,308). Certainly both of these are identical as to species. Fig. 55 is an illustration of the subgenital plate of the holotypic female described by Smith (1917) as *lineata.*

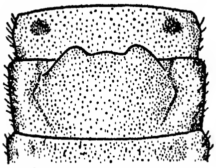


Fig. 55.—*Perlodes minor.*

Male and female specimens of *minor* determined by Klapálek are in the collection of the Museum of Comparative Zoology. When these were compared with specimens of *Perlodes* from Mount Washington, N. H., previously determined as *lineata*, and with the type of *slossonae*, no tangible differences could be found. Species of stoneflies have a much more general distribution within certain limits than literature records indicate. Although I have not examined the type of *margarita* I feel quite certain that it is the male of the species Banks described as *slossonae*—they even came from the same mountain—which in turn is the same species as *lineata* from nearby New York. On the highest mountains in the East are a few species of stoneflies found at lower levels farther north.

Klapálek's *minor* is a species of *Perlodes* having a pair of gill remnants in the adult only on the submentum. In western North America there is another species of *Perlodes* named *americana* (Klapálek) closely related on the basis of gills to *minor* but with a distinctive subgenital plate in the female and with different genitalia in the male. *P. ignota* (Smith), described (1917) without locality data, is evidently another synonym of *minor*, but the type could not be found when my studies of the *Perlodes* types were made.

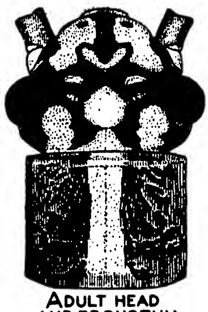
Perlodes aurea (Smith)

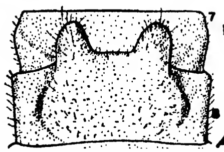
Arcynopteryx aurea Smith (1917, p. 477). Original description, ♀.

Arcynopteryx vagans Smith (1917, p. 478). Original description, ♂. New synonymy.

Arcynopteryx aurea was described from a single female (C.U. No. 1,141) from "San Diego, Calif., April 23, 1879," and *vagans* from a single male (C.U. No. 1,139) from "California."

I have studied the types of both *aurea* and *vagans* and as a result have come to the conclusion that the specimen described as *vagans* is the male of *aurea*, the name *aurea* having page priority. My reasons are as follows: Males and females agreeing with these two sexes occupy the same general territory, the opposite sex of each has not been previously located, and morphologically both are unique among North American species of stoneflies in having five pairs of gill remnants, fig. 56.





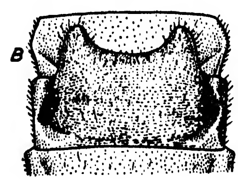


Fig. 56.—*Perlodes aurea: A*, female holotype from California; *B*, female specimen from Oregon.

An illustration of the subgenital plate of the female holotype of *aurea* is presented in fig. 56*A*. Fig. 56*B* is an illustration of the subgenital plate of a female I consider to be *aurea* from Oregon. The head and pronotum of *aurea*, as observed in an Oregon specimen, has a pattern as in fig. 56. Although Needham & Claassen (1925) mentioned the five pairs of gills in

quoting Smith's original description of *vagans*, reference to this feature was omitted when they quoted the original description of Smith for *aurea*, although the latter description contains such a statement. In the Illinois Natural History Survey collection are two nymphs from Rogue River, Ore., Sept. 29, 1932, collector, R. E. Dimick, which have five pairs of gills located as in the adult of *aurea*, and hence I consider them to be of this species.

Records for the distribution of this species based upon Illinois Natural History Survey material, or the identification of specimens for others, are as follows.

OREGON.—CORVALLIS, Alsea River: April 2, 1939, Davidson, 1♀. Near LACOMB, Roaring River: March 20, 1934, R. Dimick, 1♂. PARKDALE, east fork of Mount Hood River: May 2, 1934, R. Dimick, 1♂. ROGUE RIVER, 1,780 feet elevation: Sept. 29, 1932, R. Dimick, 2 nymphs. TILLAMOOK: March 20, 1934, Joe Schuh, 1♂.

WASHINGTON.—EASTON: April 17, 1934, G. Hoppe, 8♂, 2♀; April 25, 1934, G. Hoppe, 7♂.

Perlodes dolobrata (Smith)

Protarcys dolobrata Smith (1917, p. 469). Original description, ♀.

Perlodes dolobrata Needham & Claassen (1925, p. 52). Description, ♂.

I have not studied the typic female, in the Academy of Natural Sciences of Philadelphia, and described without locality data, and full information regarding actual number of pairs of gills is not given in the original description. The description does indicate, however, that thoracic gills are present, and it is a safe assumption that submental gills are present, thereby making Smith's key to *Protarcys* indecisive.

Needham & Claassen (1925), apparently on the basis of wing venation, described a male from "Glacier Peak and Lake Chelan Dist." as the "neallotype." This

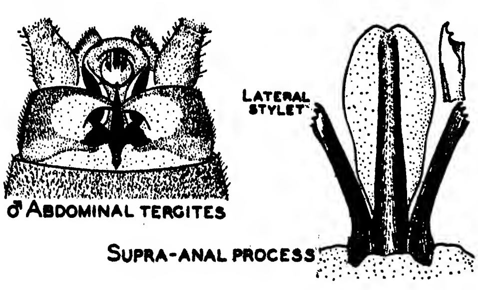


Fig. 57.—*Perlodes dolobrata.*

specimen, in the Cornell University collection, has a pair of submental gills and at least one thoracic pair (number of pairs doubtful because of poor condition of specimen). Since these authors did not figure the important genital structures of this male, I am presenting illustrations of the terminal abdominal tergites, as viewed from above, and a view of the supra-anal process and flanking lateral stylets, fig. 57. Whether this male is correctly associated with its female remains to be established by future collections.

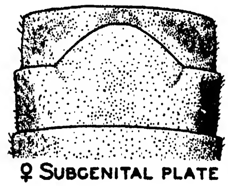
Perlodes tibialis Banks

Perlodes tibialis Banks (1914, p. 608). Original description, ♂.

Protarcys bradleyi Smith (1917, p. 470). Original description, ♂, ♀. New synonymy.

The type of *tibialis* is a male (M.C.Z. No. 11,309) and is from "Olympia Mts., Wash." A study of this male reveals it has a pair of submental gills and two pairs of gills on the sides of the thorax as Smith (1917) described for *Protarcys bradleyi*. For some reason, Smith (1917) in her account of the North American species

Fig. 58.—*Perlodes tibialis.*



of *Perlodes* failed to include any reference to the two species of *Perlodes, tibialis* and *slossonae*, described by Banks in 1914.

In the Illinois Natural History Survey collection is a male of *tibialis* from Fish Lake, British Columbia, July 23, 1908, which agrees in structural details with the type, and a female with the same data which agrees with the male in gill arrangement. It is my belief that these two specimens of opposite sex are of the same species. A study of the holotypic male and allotypic female of *Protarcys bradleyi* Smith (C.U. No. 1,135) reveals that the allotype of *bradleyi*, fig. 58, from "Rogers Pass, B. C., August 7, 1908," is identical with the female in the Survey collection I consider to be the heretofore unknown female of *tibialis*. In general the holotypic specimen agrees with the allotype, and the gill arrangement is identical. Un-

fortunately, the holotypic male of *bradleyi* has its abdomen missing, but Smith's drawing of a side view of the paragenital plate, lateral stylets and supra-anal process of the typic male are sufficient to indicate their likeness with *tibialis*. In view of (1) the distributional range involved, (2) the agreement in gill arrangement, (3) the similarity of a female evidently belonging to *tibialis* with the allotype of *bradleyi*, (4) the general agreement of a drawing of certain genitalic structures of the typic male of *bradleyi* with the male of *tibialis* and (5) the overlooking by Smith of the species *tibialis* when describing *bradleyi*, I propose that *bradleyi* be placed in the synonymy of *tibialis*.

Perlodes signata (Hagen)

Dictyopteryx signata Hagen (1874, p. 575). Original description, ♂, ♀.

Dictyopteryx irregularis Banks (1900, p. 243). Original description, ♀. Synonym.

Perlodes yosemite Needham & Claassen (1925, p. 56). Original description, ♂, ♀. New synonymy.

Smith (1917) placed *irregularis* in the synonymy of *signata*, but Needham & Claassen (1925) have treated the two as distinct. I have studied the types of both *irregularis* (M.C.Z. No. 1,130, ♀) and *signata* (M.C.Z. No. 244, ♂, ♀) and can find no good characters for their separation. The types of both species have a distinctly cleft subgenital plate in the female, and both sexes have four pairs of gills: one pair attached to submentum and three pairs on sides of thorax. The difference that Needham & Claassen (1925) mention in the shape of the tip of the genital hook of the males, in my opinion, is the result of individual variation. I have studied a male in the Cornell University collection from Paradise Valley, Wash., July 17, 1920, collected by E. P. Van Duzee, which probably is the neallotype of *irregularis*, not one of the original typic series, fixed by Needham & Claassen. This specimen was determined by Claassen as a male or *irregularis* and is in very poor condition. Enough remains to establish that it has a gill arrangement similar to that of *signata*, and therefore I believe it is of this species. The parts of the genitalia are missing.

Although the original description of *yosemite* states that the holotypic male and allotypic female are both in the collection of the California Academy of Sciences, only the allotypic female could be located by the present Curator of Insects, Dr. E. S. Ross, when I recently visited the Academy to study the stonefly types deposited there. The allotype of *yosemite* has a gill arrangement similar to that of *signata*, and the shape of the subgenital plate is of the same general type. The drawing of the subgenital plate by Needham & Claassen makes it appear that the two lobes of this plate are very angular or sharply pointed, whereas they are rounded. The characters mentioned in the original description to separate the male of *yosemite* from that of *signata* are ones which exhibit considerable variation in a series of specimens. I have no hesitancy in placing *yosemite* in the synonymy of *signata*.

Of the species of *Perlodes*, *signata* is most frequently collected, and specimens are in the Illinois Natural History Survey collection from Alberta, British Columbia, Colorado, Montana, Oregon, Utah and Washington.

Isogenus frontalis Newman

Isogenus frontalis Newman (1838*a*, p. 178). Original description, ♀.

Isogenus colubrinus Hagen (1874, p. 576). New synonymy.

In the Museum of Comparative Zoology are the typic specimens of *Isogenus colubrinus* Hagen (1 male, No. 263), *Isogenus elongatus* Hagen (3 females, No. 262), *Perla incesta* Banks (3 females, No. 10,838) and *Perla titusi* Banks (1 male, No. 10,046). After a careful study of all these types and a large series of specimens of this genus in the Illinois Natural History Survey collection, I have come to the conclusion that Needham & Claassen (1925) were correct in considering *incesta* and *titusi* as synonyms of *frontalis*. However, I dissent from Needham & Claassen (1925) in holding *colubrinus* as a distinct species and propose that it be placed in the synonymy of *frontalis*. I cannot find any differences between the type of *colubrinus* and reared females which can be accepted as *frontalis*. Furthermore, males from western states associated with females of the *frontalis–colubrinus* type are similar to reared specimens

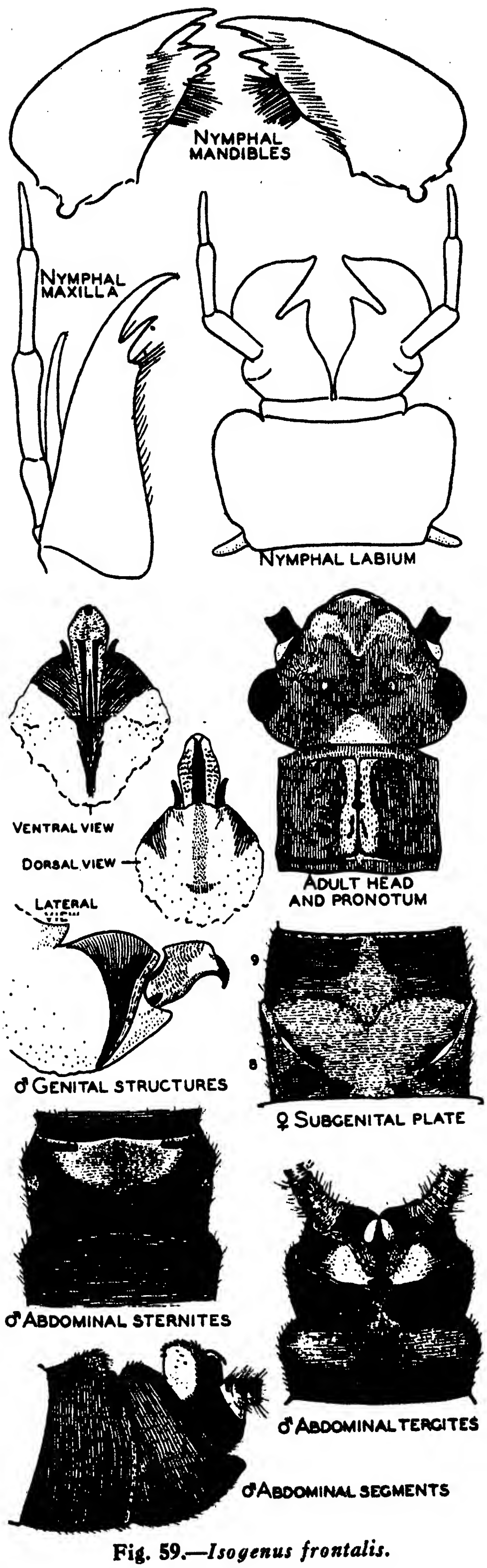


Fig. 59.—*Isogenus frontalis.*

which can be accepted as *frontalis.* In this connection it should be noted that Needham & Claassen (1925) were in doubt

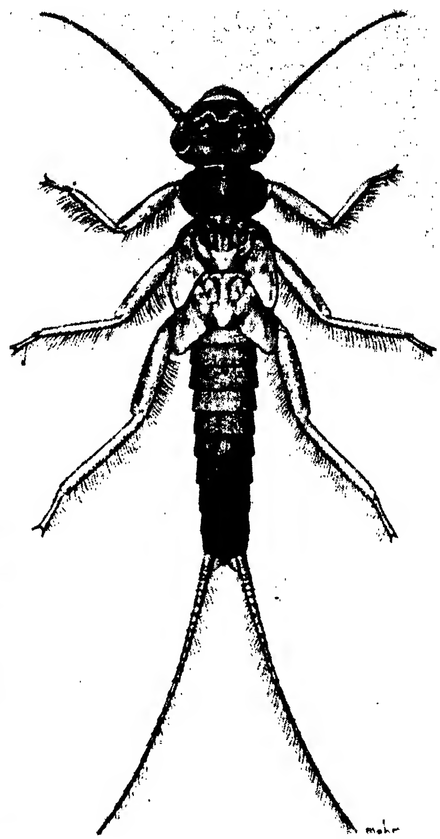


Fig. 60.—Nymph of *Isogenus frontalis.*

about their treatment of species in *Isogenus,* as indicated by their statement under *colubrinus* that "a further study of the range of variability of the three preceding may determine that they constitute but one species" (*frontalis*).

Isogenus elongatus appears to be a valid species. It can be separated from *frontalis* on the basis of the shape of the subgenital plate of its female and by the shorter headed supra-anal process of the male. All males which I can definitely assign to *elongatus* in the Illinois Natural History Survey collection have short wings, and this characteristic is true of all males assigned by Needham & Claassen (1925) to *elongatus.*

All the types of *Isogenus* studied agree in having submental gill remnants and in

this and other characters are closely related to *Perlodes* and *Hydroperla.*

To aid with the future identification of adults of *frontalis,* I wish to present the illustrations in fig. 59 made from specimens reared from nymphs in northern Michigan: head and pronotum; seventh abdominal sternite of male; dorsal and lateral views of terminal abdominal segments of male; three views of supra-anal process, lateral stylets and enveloping lobes; and the subgenital plate of the female.

Claassen (1931) does not describe the nymph of *frontalis* but questionably describes a nymph without locality label as "*colubrinus* (?)." His determination was based upon the fact that the nymph was a mature female about to produce the adult, and certain adult structures were visible. As I stated above, I consider *colubrinus* a synonym of *frontalis.* No illustration is given by Claassen of the dorsal view of the nymph, but the mouthparts are figured and agree in general with the mandibles, maxilla and labium, fig. 59, of a nymph, fig. 60, whose association with *frontalis* has been established by rearings. Claassen (1931) failed to note the submental gills, fig. 59, in his verbal description and drawing of the labium, but they are present and are a key, among other characters, to the close relationship of this genus with *Hydroperla* and *Perlodes.*

Records of *frontalis* in the Illinois Natural History Survey collection and of specimens determined for others are as follows.

ALBERTA.—MALIGNE: July 20–21, 1926, F. Neare, 1♀.

BRITISH COLUMBIA.—BIG THOMPSON RIVER: June 13, 1924, 3♂, 3♀. PRINCE GEORGE, Nechaka River: July 13–15, 1938, W. E. Ricker, 1♂, 1♀, 1 exuvia.

MANITOBA.—CHURCHILL: July 9, 1936, H. E. McClure, 2♂, 5♀.

MICHIGAN.—PEQUAMING: July 5, 1903, Morgan Hebard, 1♂. MONTMORENCY COUNTY, Hunt Creek, near lower end of swamp above county road 612: April 14, 1939, J. W. Leonard, 3 nymphs. GRAYLING, Manistee River near town: May 22, 1936, Frison & Ross, 3 exuviae. MARQUETTE COUNTY, Yellow Dog River, near Route M-35: Sept. 6, 1937, J. W. Leonard, 8 nymphs. LAKE COUNTY, Pine River at Walker Bridge: May 31, 1938, J. W. Leonard, 1♂. Montmorency County, Pigeon River, 18 miles east of VANDERBILT: Oct. 24, 1934, J. W. Leonard, 2 nymphs. SCHOOLCRAFT COUNTY, east branch of Fox River: Aug. 2, 1935, J. W. Leonard, 2 nymphs. HONOR, Platte River: May 27, 1939, Frison & Ross, 3♂ (reared), many exuviae. NIRVANA, Sanborn Creek: May 28, 1939, Frison & Ross, 4 exuviae; May 10, 1940, Frison & Ross, 11 nymphs. MAYFIELD, Boardman River: May 28, 1939, Frison & Ross, 1 exuvia. Pere Marquette River near BALDWIN: May 19, 1940, Frison & Ross, 1♀ and 1 exuvia (reared); May 9–10, 1940, Frison & Ross, 4 nymphs. BALDWIN, Pere Marquette River: May 28, 1939, Frison & Ross, 6 exuviae; May 23, 1940, Frison & Ross, 1♀ and exuvia (reared). MONTMORENCY COUNTY, Hunt Creek: Aug. 30–Sept. 3, 1940, J. W. Leonard, 1♂.

MINNESOTA.—HENNEPIN COUNTY: May 11, 1920, 1♂.

NEWFOUNDLAND.—West branch UPPER HUMBER RIVER, between falls: July 8, 1938, E. Colohan, 1♀.

OREGON.—CORVALLIS: Feb. 25, 1934, H. A. Scullen, 1♂; March 14, 1934, K. Gray, 1♂; March 19, 1934, H. A. Scullen, 1♂, 1♀; March 21, 1934, J. Roaf, 5♂, 1♀; March 13, 1935, Gray & Edwards, 1♀; March 28, 1933, J. Roaf, 1♂. Oregon State College campus, CORVALLIS: April 5, 1934, N. P. Larson, 1♀; March 28, 1935, J. Schuh, 1♂; April 9, 1935, Dimick, 1♂; Agriculture Building, April 10, 1935, 1♀; April 5, 1936, R. S. Rosenstiel, 1♀; April 11, 1935, K. Gray, 1♀. GRANGER: April 28, 1934, A. O. Larson, 1♂.

QUEBEC.—MONTREAL, Lake St. Louis near St. Bernard Island: June 30, 1941, N. Lalumiere, 4♂. LAURENTIDES NATIONAL PARK: G. Epaule Lake, Sept. 15–18, 1938, C. Gauthier, 3 nymphs; Noel Lake, Sept. 16, 1938, C. Gauthier, 2 nymphs; Big Rock Lake, July 29, 1938, Gauthier & Fournier, 2 nymphs, 2 exuviae.

WISCONSIN. — SPOONER, Namakagon River: April 29, 1939, Frison & Burks, 1♂, 2♀.

Hydroperla subvarians (Banks)

Perla subvarians Banks (1920, p. 317). Original description, ♂, ♀.

Needham & Claassen (1925) placed *subvarians* as a synonym of *Perla postica* Walker, but in view of Ricker's (1938) notes regarding the type in the British Museum, it seems advisable to use the name *subvarians* for certain eastern and northeastern specimens of *Hydroperla* at least in part called *P. postica* since 1925. Ricker's statement that the abdomen of the type is missing indicates that *postica* can never be recognized with certainty on the basis of the typic specimen alone. It is possible, however, that collecting along the MacKenzie River in northwestern Canada may some day provide esoteric information which will establish its identity.

The typic series of *subvarians*, No. 10,817, is in the Museum of Comparative Zoology, and consists of both males and females. One of the male cotypes bearing the labels "Great Falls, Va., 12-May,"

was relaxed, and the important genital characters studied in alcohol and compared with specimens in the Illinois Natural History Survey collection. It seems desirable to designate this specimen as the **lectotype**, and a female labeled "Great Falls, Va., 15-IV" as the **lectoallotype**. A male and a female of the original cotypic series, obtained by exchange, are now in the Survey collection.

Although Needham & Claassen (1925) described the adult male and female of *subvarians* (by name of *postica* Walker), they gave no illustrations of the important abdominal characters. Therefore, illustrations of the head and pronotum, the basal segments of the anal cercus, the terminal

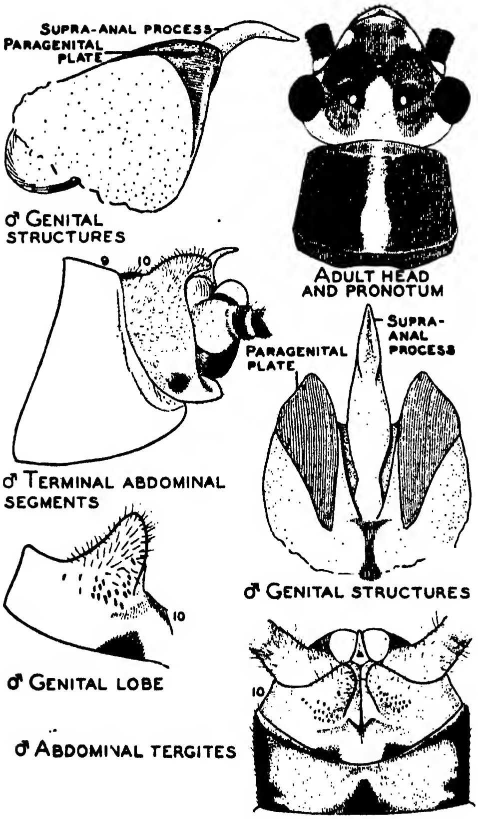


Fig. 61.—*Hydroperla subvarians.*

abdominal segments, one of the lobes on the tenth tergite, and two views of the supra-anal process and enveloping lobes are presented, figs. 61 and 62, to aid future workers with the identification of this species. These drawings are based upon a male specimen from Calais, Me., and differ from the lectotype solely in having the extreme tip of the supra-anal process more recurved backwards.

Additional records for this species in the Illinois Natural History Survey collection are as follows.

MAINE.—CALAIS, St. Croix River: June 11, 1939, P. Jennings, 1♂, 1♀.

ONTARIO.—Costello Lake, ALGONQUIN PARK, Ontario Fisheries Research Laboratory: July 3, 1939, W. M. Sprules, 1♂.

VIRGINIA.—GREAT FALLS: April 10, 1938, B. D. Burks, 1♂, 2 exuviae.

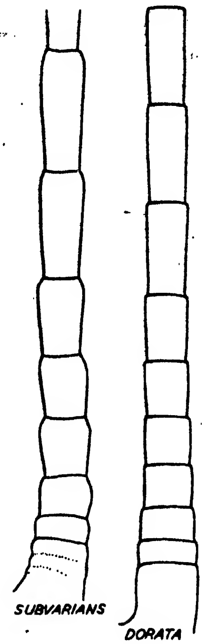


Fig. 62.—Anal cerci of *Hydroperla subvarians* and *H. dorata.*

This species differs from *varians* (Walsh), *crosbyi* (Needham & Claassen), *parallela* Frison, *harti* Frison and *dorata* Frison, the last described in this article, in lacking lateral stylets (paragenital plates). It differs from *nalata* Frison, also described in this paper, in the shape of supra-anal process and shape of lobes on tenth abdominal tergite.

Hydroperla nalata new species

MALE.—General body color black or dark brown with some yellow areas on head, thorax and abdomen. Dorsum of head and pronotum with dark and yellow areas, as in fig. 63. First abdominal tergite in part whitish, second through eighth tergites dominantly black or dark brown, ninth tergite with anterior portion dark and posterior portion yellow, tenth tergite yellow. Legs black or dark brown, with some yellow on middle part of femora. Antennae and anal cerci black or dark brown.

Head wider through compound eyes than width of pronotum; lateral ocelli about as far apart as each is distant from median ocellus, distance from inner margin

of compound eye to lateral ocellus much shorter than distance between lateral ocelli. Submental gill remnant present.

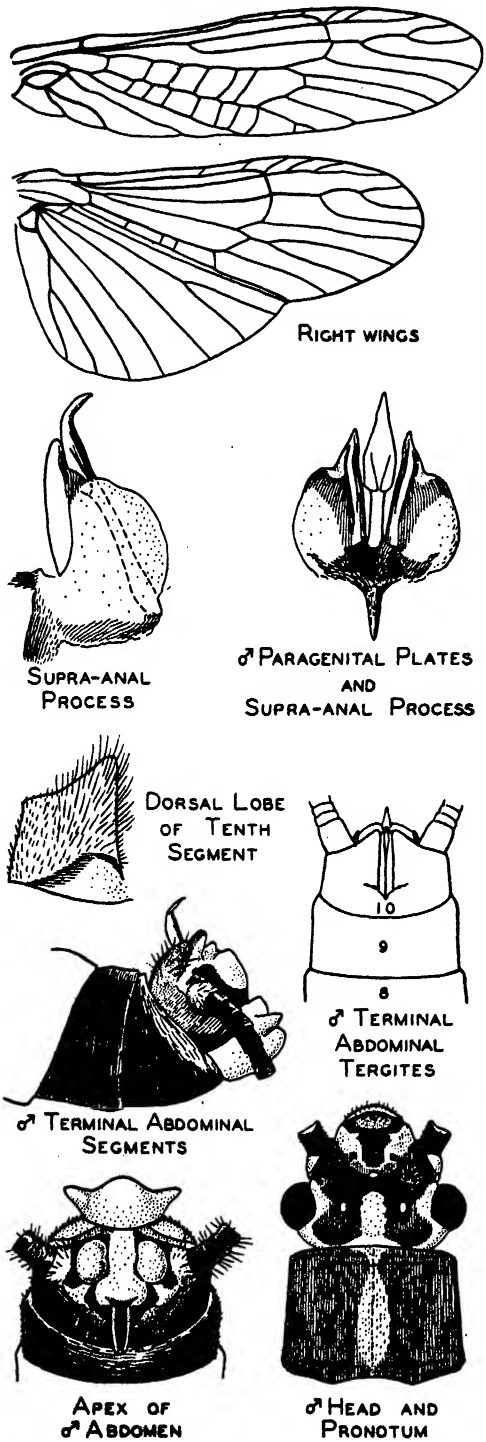


Fig. 63.—*Hydroperla nalata.*

Pronotum approximately quadrangular, broader than long, a distinct pattern of raised rugosities on surface each side of yellow, median longitudinal stripe, as shown in fig. 63.

Wings with veins black or dark brown, and membranous interspaces hyaline; venation as in fig. 63.

Abdomen with tenth tergite cleft, the lobes formed by this cleft with sides adjacent to cleft almost parallel so that lobe is broad at base and not thumblike as in some species of the genus; supra-anal

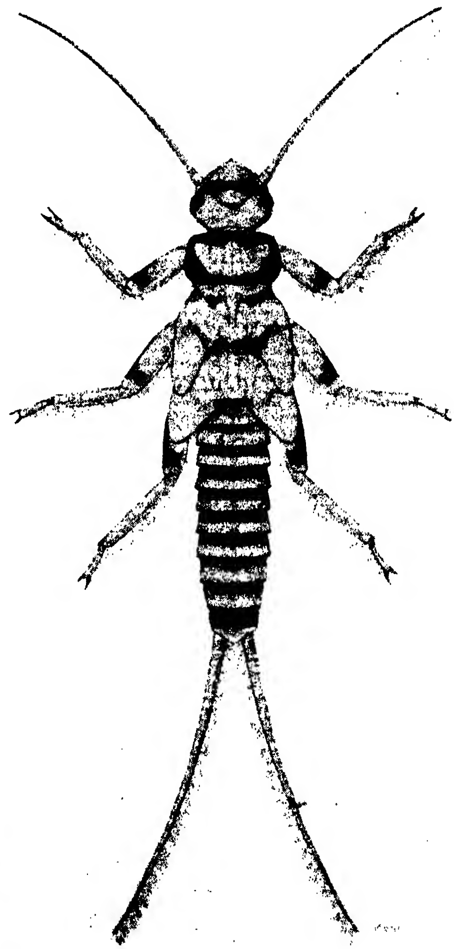


Fig. 64.—Nymph of *Hydroperla nalata.*

process tapering to a point which is somewhat recurved backwards at tip, without lateral stylets (paragenital plates) flanking it, and enveloped by two lobes which are partly sclerotized, fig. 63; aedeagus as in fig. 63.

Length to tip of wings 17 mm.; length to tip of abdomen 14 mm.

Holotype, male. — WASHTENAW COUNTY, Huron River, T25, R5E, Sec. 5, Mich.: May 31, 1937, F. E. Lyman.

Paratypes. — MICHIGAN. — WASHTENAW COUNTY: Same data as for holotype, 6♂.

NYMPH.—General body color yellow with dark brown or black markings, as

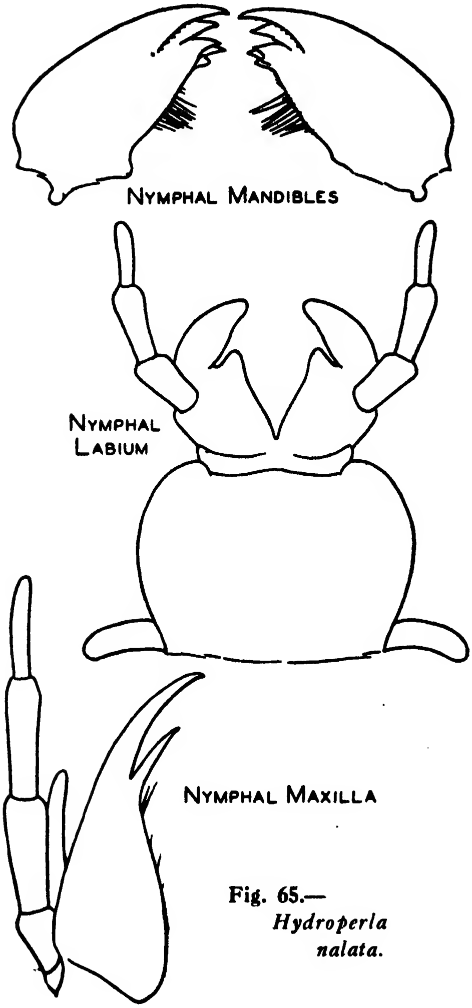


Fig. 65.—*Hydroperla nalata.*

in fig. 64. Thoracic and abdominal gills absent. A small finger-like gill, fig. 65, at each outer posterior corner of submentum. Mandibles, labium and maxillae as in fig. 65. Occipital ridge lacking.

Approximately mature specimens with body length of 18 mm.

Nymphal records: Same locality as for holotype with date records as follows: Jan. 29, 1937, 1 nymph; Feb. 4–20, 1937, 3 nymphs; April 4–9, 1937, 5 nymphs; May 6, 1937, 3 nymphs; April 10–28, 1938, 6 nymphs.

This species differs from *varians* (Walsh), *crosbyi* (Needham & Claassen), *parallela* Frison, *harti* Frison and *dorata* Frison, the last described in this paper, in lacking lateral stylets (paragenital plates). It differs from *subvarians* (Banks) in shape of supra-anal process and shape of lobes on tenth abdominal tergite.

Hydroperla dorata new species

MALE.—General features about as in *nalata* Frison, described in this paper. Head and pronotum with color pattern as in fig. 66. Important distinctive characters are as shown in figs. 62 and 66: Abdomen with tenth tergite cleft, the lobes formed by this cleft with sides adjacent to cleft not parallel and lobes somewhat thumblike; supra-anal process with tip strongly recurved backwards and shaped as in fig. 66; with lateral stylets (paragenital plates) flanking supra-anal process, both enveloped by two lobes which are partly sclerotized. Basal segments of anal cerci as in fig. 62.

Length to tip of wings 18 mm.; length to tip of abdomen 16 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite with posterior portion forming a subgenital plate shaped as in fig. 66.

Holotype, male.—Near Baldwin, Pere Marquette River, Mich.: May 10, 1940, reared from nymph, T. H. Frison & H. H. Ross.

Allotype, female.—Same data as for holotype.

Paratypes. — MICHIGAN. — Near BALDWIN: same data as for holotype, 1♂; same data as for holotype except not reared, 1♀.

PENNSYLVANIA.—ANALOMINK, Brodhead Creek: April 15, 1939, 1♂; April 23, 1939, 1♂, 1♀; April 27, 1940, 1♂; all P. Jennings.

NEW YORK.—MOUNT MARCY: June 29, 1940, H. Dietrich, 1♂. PHOENECIA: May 5, 1940, P. Jennings, 2♂. SCHOHARIE: April 28, 1938, 1♂.

NYMPH (description based upon exuvia).—General body color yellow with dark brown on black markings as in fig. 67. Thoracic and abdominal gills lacking. A small finger-like gill at each outer posterior corner of submentum. Mandibles, labium and maxillae as in fig. 66. Occipital ridge lacking.

Mature specimens with body length of approximately 21 mm.

Nymphal and exuvial records: Near BALDWIN, Pere Marquette River, Mich., May 9–10, 1940, T. H. Frison & H. H. Ross, 17 exuviae; 1 nymph ready to produce adult, in poor condition, taken in spider web, otherwise with same data as for exuviae.

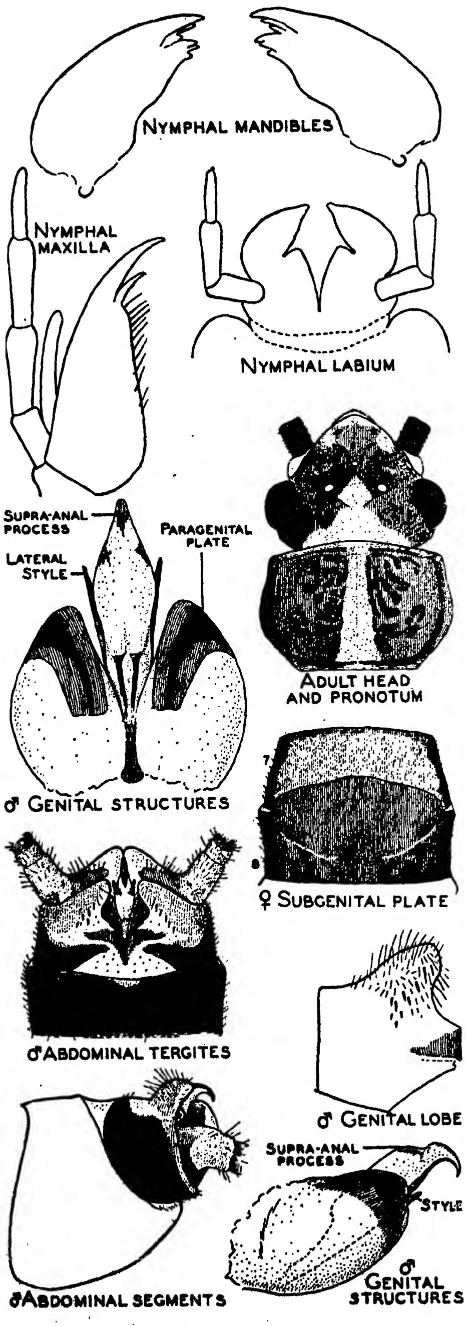


Fig. 66.—*Hydroperla dorata.*

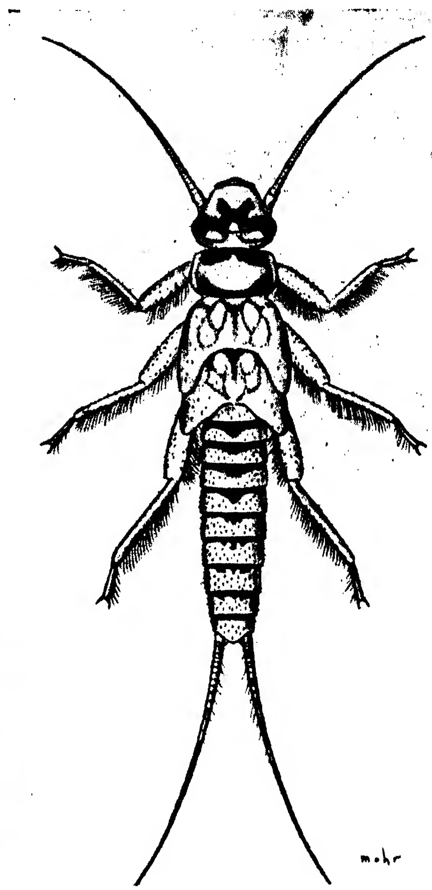


Fig. 67.—Nymph of *Hydroperla dorata.*

This species differs from *subvarians* (Banks) and *nalata* Frison by having lateral stylets (paragenital plates). It differs from *varians* (Walsh), *crosbyi* (Needham & Claassen), *parallela* Frison and *harti* Frison in the shape of the supra-anal process and lobes formed by cleft tenth abdominal tergite. The nymph has a color pattern distinct from that of the nymphs of *crosbyi* and *harti* as illustrated by me (1935*a*), and from that of *varians* as illustrated by me (1937).

Hydroperla olivacea (Walker)

Perla olivacea Walker (1852, p. 144). Original description, ♂.

Perla olivacea Ricker (1938, p. 142). Description of ♀.

Hydroperla olivacea has rarely been recorded in literature, except in catalogs, since its original description and it was entirely omitted by Needham & Claassen (1925) in their *Monograph.* Walker's (1852) description was based upon a specimen from "St. Martin's Falls, Albany River, Hudson's Bay." Klapálek (1912) gave notes and an illustration of Walker's type in the British Museum. More recently Ricker (1938) redescribed and figured the typic male; in addition he described a female associated with the typic male as the "Neo-allotype," and recorded an additional male specimen from "Hudson's Bai, 1881," in the collection of the Vienna Museum.

In June, 1936, Dr. H. H. Ross and I collected at the Namakagon River, near Spooner, Wis., a single cast skin of a nymph easily distinguished from all other known North American stonefly nymphs by virtue of a peculiar curled process at apex of abdomen. In 1939, exuvial specimens of this same species were found at three places in northern Michigan; which suggested that an earlier trip the next year might result in the capture of adults. Accordingly, a trip to northern Michigan was made May 9–12, 1940, with the result that numerous exuviae, one dead adult male in a spider web, one dead adult male partially emerged from nymphal skin in a spider web and one perfect live specimen of a male adult were collected.

Previous to the collection of adult specimens in 1940, Ricker's (1938) illustration of the type of *olivacea* suggested that my exuviae with unique apical abdominal processes might be the cast skins of that species, since the adult male of *olivacea* has a most extraordinarily long supra-anal process. Finding adult males of *olivacea* in spider webs under bridges where exuviae were plentiful, and beating a fresh live male specimen from a bush where exuviae were present, afford sufficient evidence with such unique adults and nymphs to associate them definitely as the same species. Ricker's illustration of the typic male of *olivacea* is sufficient, too, to enable me to assign without question my northern Michigan specimens to the species *olivacea.* In many respects the stonefly fauna of northern Michigan is similar to that of Ontario, Canada. As a further aid to the future recognition of this species, an illustration showing the color pattern of the dorsum of the head and thorax, and important structural features of the male, fig. 68, is presented.

Based upon exuviae and one shriveled nymph found dead in a spider web beneath a bridge, the following description of the heretofore unknown nymph of *olivacea* is presented.

NYMPH. — General color yellowish brown with black or fuscous areas as in fig. 69; particularly noticeable are the dark transverse bands on the anterior and posterior margins of the abdominal tergites, the bands on the anterior margins broadest.

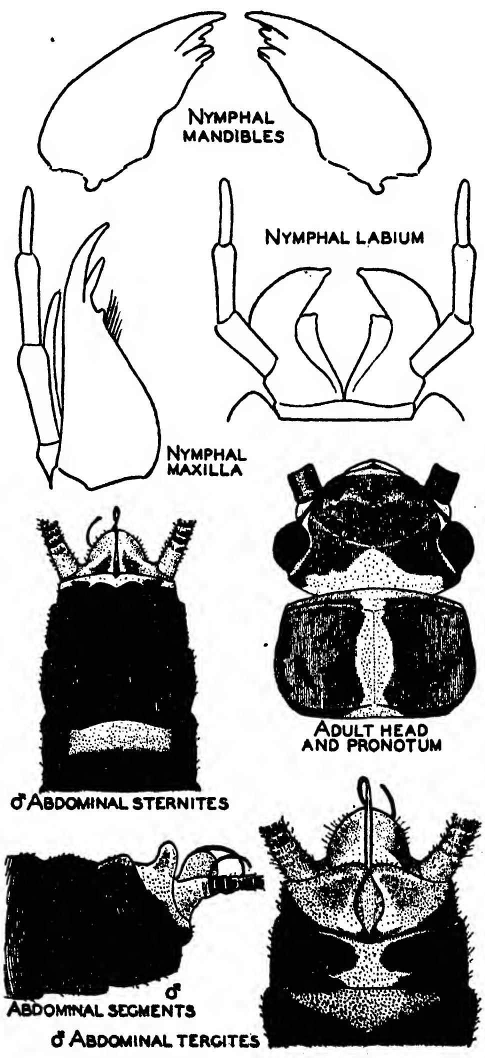


Fig. 68.—*Hydroperla olivacea.*

Labium, maxillae and mandibles as in fig. 68.

Dorsum of abdomen terminating in a coiled tubular projection not heretofore observed in any other described stonefly nymph, fig. 69.

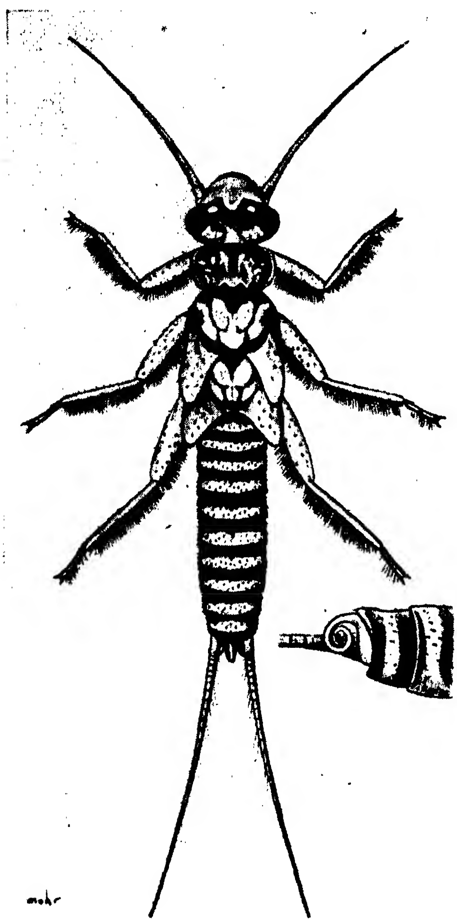


Fig. 69.—Nymph of *Hydroperla olivacea.*

No thoracic or anal gills; submental gills present as in all *Hydroperla.*

Approximate body length of mature nymph 15 mm.

Records of this species are as follows.

MICHIGAN.—BALDWIN, Pere Marquette River: May 28, 1939, 4 exuviae, and May 9–10, 1940, 19 exuviae, 1 nymph, 1♂ adult, T. H. Frison & H. H. Ross. HONOR, Platte River: May 27, 1939, 14 exuviae, and May 10, 1940, 22 exuviae, 1 partially emerged adult, T. H. Frison & H. H. Ross. NIRVANA, Sanborn Creek: May 28, 1939, T. H. Frison & H. H. Ross, 5 exuviae. PEACOCK, Little Manistee River: May 10, 1940, T. H. Frison & H. H. Ross, 10 exuviae. NAHMA JUNCTION, Sturgeon River: May 12, 1940, 8 exuviae, 1♂ adult, T. H. Frison & H. H. Ross. LAKE COUNTY, Pine River Station 4: May 16, 1938, O. H. Clark, 1♂ adult.

WISCONSIN. — SPOONER, Namakagon River: June 5–6, 1936, T. H. Frison & H. H. Ross, 1♂ exuvia.

Hydroperla parallela Frison

Hydroperla parallela Frison (1936, p. 261). Original description, ♂.

Hydroperla parallela Frison (1937, p. 90). Description, ♀.

Hydroperla parallela Ricker (1939, p. 23). Additional British Columbia records.

Since my original description of the male (1936), and subsequent description of the female (1937), I have examined nymphal specimens which I am certain are *parallela*, and the following description is presented.

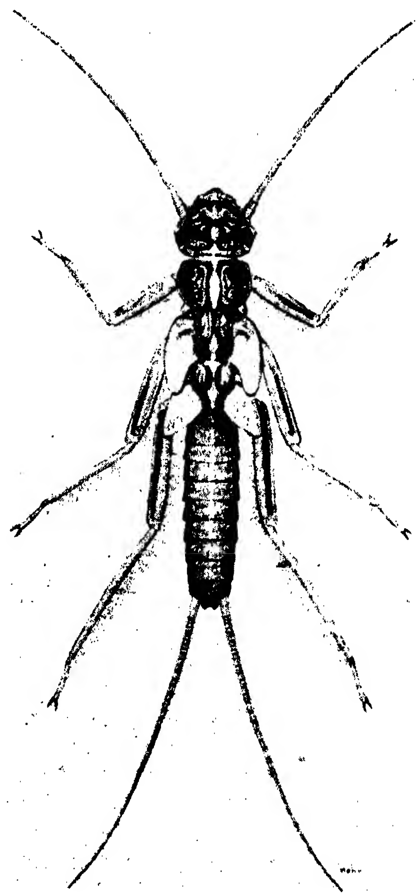


Fig. 70.—Nymph of *Hydroperla parallela.*

NYMPH.—General color of head, thorax and abdomen brownish with paler spots and intersegmental areas as in fig. 70. Antennae, legs and anal cerci yellowish brown.

Head with three ocelli forming a nearly equilateral triangle, each lateral ocellus about as far apart as each is distant from

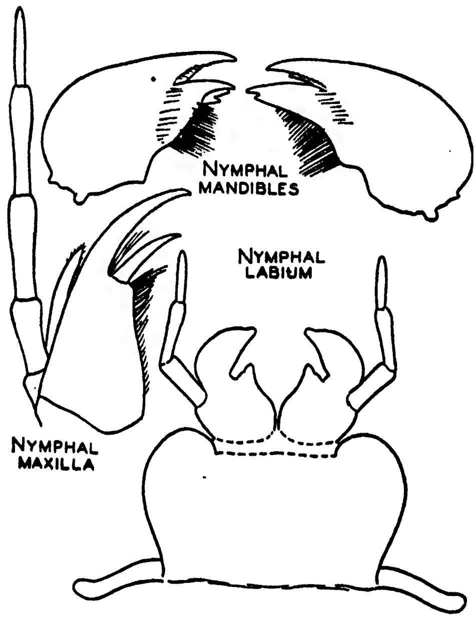


Fig. 71.—*Hydroperla parallela.*

inner edge of compound eye. A partial occipital ridge, interrupted in middle, accentuates posterior margin of each conspicuous eyelike spot adjacent to and between compound eyes and borders hind margin of compound eye. Labium, maxillae and mandibles as in fig. 71.

Pronotum about two-thirds as long as broad, all angles well rounded. Legs slender, not greatly flattened.

Abdominal tergites well covered with numerous conspicuous, short, stout setae. Cerci long, many segmented, segments progressively longer from base to apex, a longitudinal row of long, fine setae on dorsal surface in addition to smaller ones encircling segments.

Approximately mature specimens with a body length, exclusive of appendages, of about 23 mm.

A finger-like submental gill at each outer posterior corner of submentum, fig. 71; thoracic and abdominal gills entirely lacking.

Nymphal and exuvial records are as follows.

BRITISH COLUMBIA.—North of RUSKIN, Stave Lake Dam: April 15, 1938, W. E. Ricker, 1 nymph, 2 exuviae. CULTUS LAKE, Chilliwack River: April 26–27, 1937, W. E. Ricker, 2 nymphs. SARDIS, Vedder River: July 23, 1936, H. H. Ross, many exuviae.

IDAHO.—South central part of state: 1938, L. H. Smith, 1 nymph.

OREGON.—CORVALLIS, Marks Creek: Feb. 26, 1938, B. White, 1 nymph. MCKENZIE RIVER: March 9, 1939, J. E. D., 1 exuvia.

WASHINGTON.—GREEN and CEDAR RIVERS: April 1, 1939, L. Lambuth, 2 nymphs.

New adult records are as follows.

BRITISH COLUMBIA.—CULTUS LAKE, Chilliwack River: May 9, 1937, W. E. Ricker, 4♂.

OREGON. — MULTNOMAH FALLS, Multnomah County: April 8, 1939, S. G. Jewett, Jr., 19♂, 3♀. PORTLAND, Multnomah County: March 17, 1939, S. G. Jewett, Jr., 1♂. Clatsop County, Herman Creek, tributary of Mecanicum River, 6 miles south of SEASIDE: Feb. 18, 1939, S. G. Jewett, Jr., 2♂. CLACKAMAS COUNTY: Molalla River, Feb. 23, 1939, Rock Creek, tributary of Clackamas River, Feb. 20, 1939, and Wildcat Creek, tributary of Sandy River, March 31, 1939, S. G. Jewett, 1♂, 2♀. COLUMBIA COUNTY: south of north fork of Scappoose Creek, Feb. 17, 1939, and Gnat Creek, Feb. 19, 1939, S. G. Jewett, Jr., 3♂, 1♀. ST. HELENS, Milton Creek, Columbia County: Feb. 19, 1939, S. G. Jewett, Jr. 1♂. HERMAN, Oregon National Forest, 700 feet altitude: April 18, 1920, A. C. Burrill, 1♂, 1♀.

UTAH.—LOGAN CANYON: April 23, 1938, R. E. Nye, 1♀.

Dictyopterygella knowltoni Frison

Dictyopterygella knowltoni Frison (1937, p. 89). Original description, ♂.

The original description of *knowltoni* was based upon a single holotypic male from Logan, Utah. Since then I have examined additional males and recognized the females. A brief description of the heretofore undescribed female follows.

FEMALE.—Similar in most morphological characters to the male (Frison 1937). Chief distinguishing characters are as follows: Subgenital plate, fig. 72, somewhat protruding over ninth sternite and inset on eighth sternite; baso-ventral, subanal plates heavily sclerotized, projecting backwards along median cleft where right and left plates meet to form a short, blunt lobe suggesting more modified subanal lobe projection in male; length 33 mm. to tip of wings and 20 mm. to tip of abdomen.

Allotype, female.—Logan Canyon, Utah: April 23, 1938, R. E. Nye. Taken at same time and place as male of this species.

Records for this species which have accumulated since the original description, in addition to those for the allotype, are as follows.

Colorado.—Estes, Mill Creek: June 11, 1937, 1♂, 1♀.

Oregon.—Ochoco Creek: May 3, 1939, 1♀.

Utah.—Big Cottonwoods Canyon: April 24, 1937, G. F. Knowlton & F. C. Harmston, 1♀. Logan Canyon: June 18, 1937, Knowlton & Nye, 1♀; April 23, 1938, W. P. Nye, 1♂, 1♀; April 19, 1940, R. E. Nye, 1♂, 1♀. East of Daniels: June 4, 1940, Knowlton & Vansell, 1♀.

The above specimens confirm the statement made when the type, a specimen relaxed from a pin mount, was described, that the submental gill as it occurs in *Hydroperla* and *Perlodes* is lacking. However, there is a slight trace of a nipple-like projection at each outer posterior corner of the submentum suggestive of an atrophied submental gill. A similar situation is found in the case of *Diploperla hastata* (Banks) from eastern North America and other species of *Diploperla*. I now believe that the genus *Dictyopterygella*, including *knowltoni*, should be placed in the family Perlodidae, which is the family where this genus has been placed by recent European authors.

The thoracic cervical sternites of *knowltoni*, and various species of *Perlodes*, *Hydroperla* and *Perla*, possess weakly sclerotized folds or bulbous areas which probably play a part in respiration.

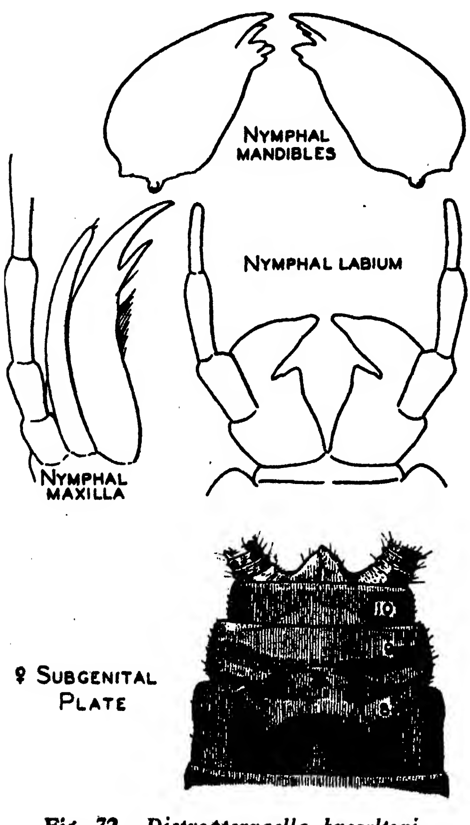


Fig. 72.—*Dictyopterygella knowltoni.*

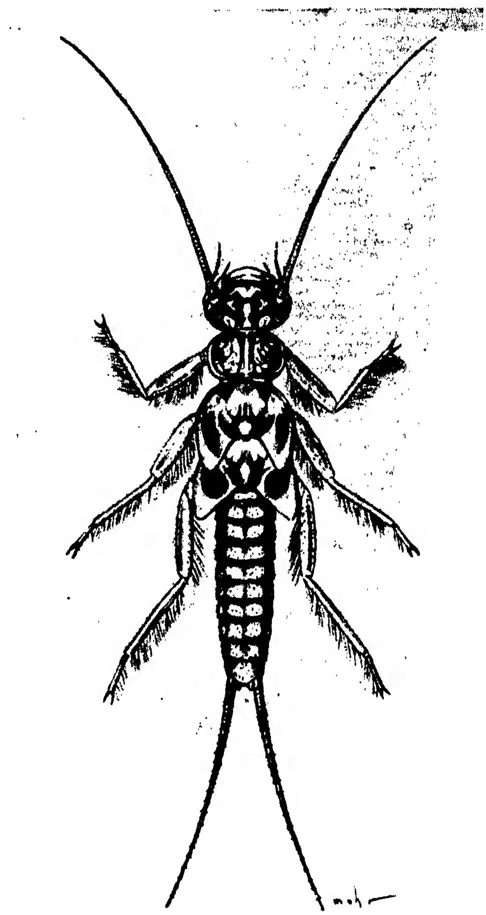


Fig. 73.—Nymph of *Dictyopterygella knowltoni.*

In the original description of the male of *knowltoni* (Frison 1937), an error occurs in regard to comparative lengths of tarsal segments. This statement should read: first and second tarsal segments together about one-half as long as third, first tarsal segment longer than the second.

Among a lot of stonefly specimens lent to Dr. W. E. Ricker by the Canadian National Collection, Ottawa, Canada, and subsequently sent me for examination, are nymphs, adult females and an exuvia

from British Columbia which certainly belong to the genus *Dictyopterygella.* Since the only known western species of this genus is *knowltoni,* and since I am unable to separate these British Columbian females from ones here considered and described as the species *knowltoni,* I am identifying these specimens as of this species. The description of this previously unknown nymph follows.

NYMPH. — General color yellowish brown with black or fuscous areas as in fig. 73; labium, maxillae and mandibles as in fig. 72; bases of maxillae somewhat extending out from sides of head and visible from above; subanal lobes prominent; no thoracic or anal gills; no distinct submental gills present but at the point where such gills are present in *Hydroperla* or *Isogenus* there is a small, nipple-like protuberance. Approximate length of mature nymph 18 mm.

The nymphs upon which this description is based were collected at "Shingle Creek, Penticton, British Columbia, April 19, 1935, A. N. G.," and are associated with two adult females from the same place collected on April 19, 1935, together with one adult female reared from nymph on May 1, 1935, and associated with its exuvia.

It is interesting to note that the first description of a nymph of *Dictyopterygella,* for the British species of *bicaudata* (Linnaeus), has only recently been published by Hynes (1941). The nymph of *knowltoni* agrees very closely with the nymph of *bicaudata* as described and figured by Hynes.

Diploperla Needham & Claassen

Diploperla Needham & Claassen (1925, p. 286). New subgenus.

In my paper on the *Stoneflies, or Plecoptera, of Illinois* (1935*a*), I found it desirable to remove the genera *Perlodes* and *Isogenus,* and several species for which I proposed the generic name of *Hydroperla,* from the family Perlidae and to place them in the family Perlodidae. This left a residue of North American species in the genus *Perla* (in the sense of Needham & Claassen 1925) which represented several distinct complexes of species, subgenera or genera. The problem of the correct use of the generic name of *Perla* and the status of certain North American genera were not considered further in my 1935 paper because that paper was primarily a study of the Illinois species, not a monograph of the North American species.

The description in this paper of new species of stoneflies from various parts of North America has now forced me to decide upon the use of certain generic names previously dodged. In my 1935*a* paper, I wrote, "Although Needham and Claassen (1925) have placed several species of *Perla* (in the broad sense as used by them) in the subgenus *Perla* Geoffroy (*s. str.*) it is even doubtful whether the true *Perla* in the restricted sense as used by Klapálek (1923*a*) occurs in North America." To get further data regarding the status of *Perla* I wrote in 1936 to Mr. D. E. Kimmons of the British Museum requesting information about the genotype of *Perla* Geoffroy and its taxonomic characters. Mr. Kimmons' reply confirmed my previous suspicions and also added additional complicating data. Briefly, his report indicated (1) that the genotype of *Perla* Geoffroy is *Phryganea bicaudata* Linnaeus and not *Perla bipunctata* Pictet as selected by Klapálek (1923*a*) or *Perla maxima* (Scopoli) as stated by Needham & Claassen (1925), and (2) that the name *Perla* probably should be associated with species now placed under another genus and family of stoneflies. Since this is a nomenclatorial problem primarily of concern to European entomologists, I am not assuming to settle the points involved at this time.

However, in view of the probably erroneous use of the generic name of *Perla* in European literature and the certainty that most, if not all, North American species placed in *Perla* in the past are not congeneric with the type of *Perla,* it is unwise to continue to describe new North American species under the generic name of *Perla.*

Needham & Claassen (1925) listed 27 species under the genus *Perla* in their tabulation of the North American stoneflies. Since then the number of species left standing unchallenged in *Perla* (sense of Needham & Claassen) has been reduced as follows: (1) a special genus *Claassenia* Wu (1934) has been erected for *languida* (Needham & Claassen) notwithstanding that among the North American

species *languida* is morphologically perhaps the closest representative of the genus *Perla* as now—but probably erroneously—used in Europe (sense of Klapálek 1923*a*); (2) the recognition of *Togoperla* and *Neophasganophora* as valid North American genera (Frison 1935*a*) removed *immarginata* (Say), *media* (Walker) and *capitata* (Pictet) from the list; (3) the erection of the genus *Hydroperla* (Frison 1935*a*) removed the names of *crosbyi* (Needham & Claassen) and *varians* (Walsh); (4) the placement (Frison 1935*a*) of *duplicata* (Banks) in the genus *Isoperla*; and (5) the placement of *kansensis* (Banks) in *Togoperla* (Frison 1937) removed an additional species.

In this paper the list is further reduced as follows: (1) *Perla sabulosa* Banks is placed in the genus *Acroneuria*, and *A. depressa* Needham & Claassen is shown to be a synonym of it; (2) *Perla postica* Walker is considered to be unrecognizable at present and *subvarians* (Banks), belonging to the genus *Hydroperla*, is the name to be associated with some at least of the Needham & Claassen records given under the name *postica*.

It is quite evident from my studies to date that the species now left in *Perla*, some of which may later fall in synonymy, constitute several complexes or species groups, represented by such divergent forms as *modesta* Banks, *luctuosa* Banks and *bilobata* Needham & Claassen. It is highly probable also that one or two of these species will in the future be shifted to such genera as *Isoperla* or *Hydroperla*, since their generic relationships are somewhat obscured now because of the poor condition of the types and the lack of other material which can be definitely associated with these names. Until these species are better known, however, it seems advisable to record them all under a single generic name.

In view of the fact that it now seems unwise to use the generic name of *Perla* for these species, and for the two new species described in this article, the problem of selecting a generic name is presented. It is now my belief that the species *duplicata* placed by Banks in *Perla* should not be included in *Isoperla*, as I proposed in 1935, and that it is more closely related to the species group represented by *modesta* Banks. This realignment of *duplicata* with such species as *modesta*, and my present belief that the species now under discussion should be grouped as a unit until they are better known, make possible the use of the name *Diploperla* Needham & Claassen (1925) for these species, since *Diploperla* was proposed for the species *duplicata* and *bilobata*. This action is advantageous in that it makes possible the use of a name already in literature and removes the controversial name of *Perla*.

Therefore, until additional information warrants other generic treatment, I propose to group under the generic name of *Diploperla* Needham & Claassen (*s.l.*) the species described under the following names: *Perla innubila* Needham & Claassen, *Perla alameda* N. & C., *Perla expansa* Banks, *Isogenus hastatus* Banks, *Perla fugitans* N. & C., *Perla nona* N. & C., *Perla aestivalis* N. & C., *Perla modesta* Banks, *Perla verticalis* Banks, *Perla tinctata* Claassen (*nom. nov.* for *tincta* N. & C.), *Perla sorpta* N. & C., *Dictyogenus ? phaleratus* Smith, *Perla misnoma* Clsn. (*nom. nov.* for *obscura* N. & C.), *Perla errata* Clsn. (*nom. nov.* for *venosa* N. & C.), *Perla bilobata* N. & C., *Perla duplicata* Banks, *Perla luctuosa* Banks and *Perla ramosa* N. & C. I am also assigning to this genus three new species described in this article.

Since Needham & Claassen (1925) did not select a genotype for *Diploperla*, I designate the species hitherto known as *Perla bilobata* Needham & Claassen as the **genotype** because it is one of the two originally included species.

The proper family placing of this genus has many puzzling aspects. The cleft tenth abdominal tergite, supra-anal process and associated structures in the male, as well as the wing venation and other features of both sexes, suggest a close relationship with *Hydroperla*. Lack of distinct submental gills is annoying from the standpoint of a family key character, but there is a suggestion of these submental gills in the small nipple-like protuberance where a long submental gill is present in other genera of this family.

Diploperla bilobata
(Needham & Claassen)

Perla bilobata Needham & Claassen (1925, p. 95). Original description, ♂, ♀.

Perla bilobata Claassen (1931, p. 54). Nymphal description.

Claassen's (1931) description of the nymph of this species was based upon nymphal skins from "Old Forge, New York," and, although the mouthparts were illustrated, no illustration of the entire nymph was presented.

During the course of field work near Gatlinburg, Tenn., in 1930, numerous nymphs of this species were collected and both males and females reared. Since no illustration of this nymph exists in literature, fig. 74 is presented. The unusual

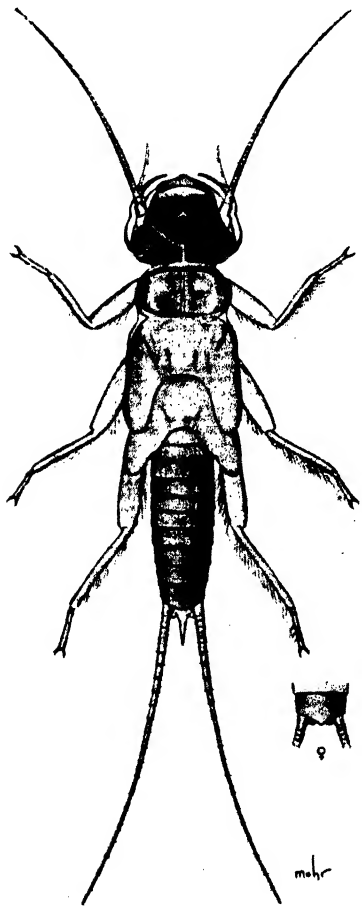


Fig. 74.—Nymph of *Diploperla bilobata.*

appendage at the end of the abdomen in the nymphal male, lacking in the female, was not noted by Claassen in his description. The mouthparts of the nymph are as in fig. 75.

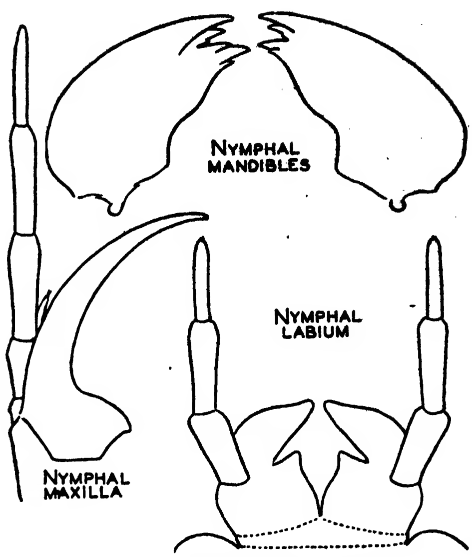


Fig. 75.—*Diploperla bilobata.*

Records for this species in the Illinois Natural History Survey collection are as follows.

TENNESSEE.—Great Smoky Mountains National Park, GATLINBURG: June 14, 1940, Frison *et al.*, 2♀, 1 exuvia, 4 nymphs; June 17, 1940, Frison *et al.*, 1♀; June 18, 1940, Frison *et al.*, 1♀ with exuvia (reared); June 19, 1940, Frison *et al.*, 2♀ with exuviae (reared), 1♂; June 20, 1940, Frison *et al.*, 1♀ with exuvia (reared); June 21, 1940, Frison *et al.*, 1♀ with exuvia (reared); June 24, 1940, Frison *et al.*, 1♀ with exuvia (reared), 2♀; Le Conte Creek, May 14, 1939, Frison & Ross, 7 nymphs; Le Conte Creek, June 14, 1940, Frison *et al.*, 2♂, 4♀; Cades Cove, June 13, 1940, Frison *et al.*, 1♀ with exuvia and 1♂ with exuvia (reared), many nymphs; Fighting Creek Gap, May 15, 1939, Frison & Ross, 1 nymph.

NORTH CAROLINA.—SMOKEMONT, Oconaluftee Creek: May 28, 1934, T. H. Frison, 1 nymph. MACON COUNTY: Big Creek above Lake Randall, June 20, 1939, Thelma Howell, 1 nymph; Nantahala River, May 30, 1939, Thelma Howell, 1 nymph. BALSAM: April 24, 1938, Ross & Burks, 9 nymphs.

Diploperla modesta (Banks)

Perla modesta Banks (1908*a*, p. 255). Original description, ♂, ♀.

It was my good fortune in August, 1940, while in Wyoming, to rear several male and female specimens of *modesta* and thus definitely associate the nymph of this species with its adult. Since the nymph has not been previously described or illustrated, at least under the name *modesta*, I am presenting the following description.

NYMPH.—General color yellow or yellowish brown with darker areas on head, thorax and abdomen, as in fig. 76. Antennae, legs and anal cerci mostly yellowish.

Head with three ocelli forming an almost equilateral triangle, the lateral ocelli about as far apart as each is distant from inner edge of compound eye; no occipital ridge; basal segments of mouthparts conspicuously extending far out laterally from the side of head so that head appears much broader than thorax. Labium, maxillae and mandibles as in fig. 77.

Pronotum much broader than long; margins darkly bordered and central area light colored, rugosities very faint.

Abdominal tergites mostly yellowish with dark transverse markings on anterior and posterior margins, fig. 76; tergites with scattered, short, stout setae. Cerci long, many segmented, segments progressively longer from base to apex, a longitudinal row of long, fine setae on dorsal

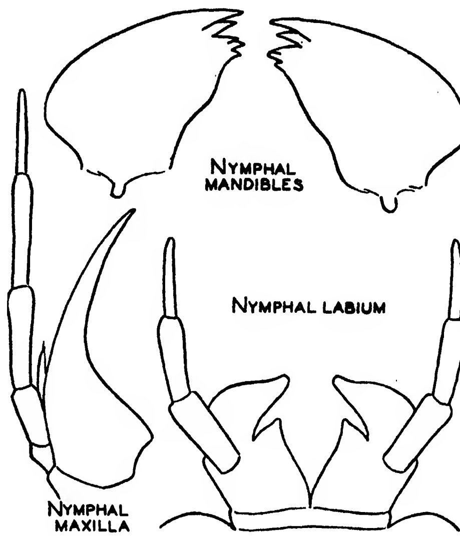


Fig. 77.—*Diploperla modesta.*

surface in addition to short, stout setae encircling apex of each segment.

Approximately mature specimens with a body length, exclusive of appendages, of 16 mm.

A small nipple-like projection at each outer posterior corner of the submentum suggestive of an atrophied submental gill.

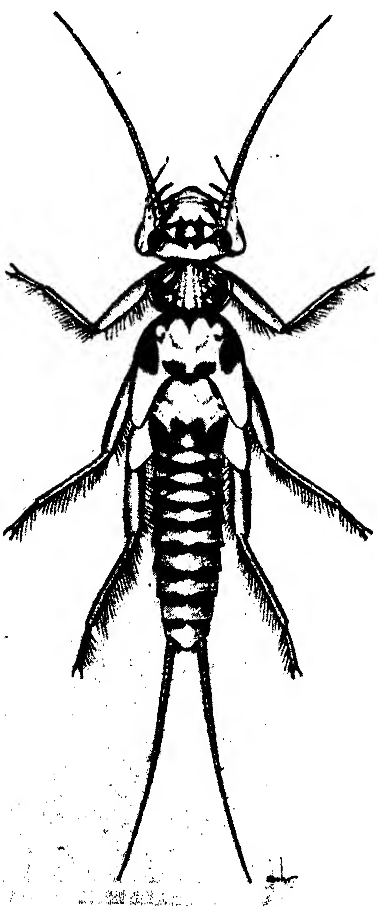


Fig. 76.—Nymph of *Diploperla modesta.*

Since there are only a few records of this species in the literature, I present the following.

COLORADO. — PINGREE PARK: Aug. 15–22, 1924, Drake & Hottes, 1 ♀. ROCKY MOUNTAIN NATIONAL PARK, Fall River and Glacier Creek: Aug. 15–17, 1940, T. H. Frison & T. H. Frison, Jr., 2 ♂, 3 ♀ (reared), 1 nymph, exuviae.

IDAHO.—VICTOR, Moose Creek: Aug. 12, 1940, T. H. Frison & T. H. Frison, Jr., 1 ♂, 1 ♀, 4 exuviae.

MONTANA.—SALTESE: July 9, 1936, H. H. Ross, 1 ♂ (reared). SILVER GATE, Soda Butte Creek: Aug. 2, 1940, T. H. Frison & T. H. Frison, Jr., 4 nymphs.

OREGON. — WALLOWA COUNTY, Lick Creek: Aug. 12, 1937, 1 ♀. BENTON COUNTY, Muddy Creek: April 12, 1938, S. G. Jewett, Jr., 1 ♂.

UTAH.—LOGAN CANYON: At light, July 29, 1937, Knowlton & Harmston, 3 ♂, 3 ♀; Aug. 1, 1937, Smith & Harmston, 1 ♂, 3 ♀; July 25, 1938, Knowlton & Harmston, 5 ♂, 7 ♀.

WASHINGTON.—CASHMERE, Wenatchee River: July 10, 1936, H. H. Ross, 1 ♂, 2 ♀.

WYOMING. — PAHASKA TEPEE, north fork Shoshone River: July 29, 1940, T. H. Frison & T. H. Frison, Jr., 1 exuvia. Near WAPITI, north fork Shoshone River: July 30, 1940, T. H. Frison & T. H. Frison, Jr., 1 ♂, 1 ♀ (both

reared), 4 nymphs. YELLOWSTONE NATIONAL PARK, Soda Butte Creek: Aug. 2, 1940, T. H. Frison & T. H. Frison, Jr., 1 ♂. GRAND TETON NATIONAL PARK, Beaver Creek and Cascade Canyon: Aug. 7–9, 1940, T. H. Frison & T. H. Frison, Jr., 5 ♂, 6 ♀ (1 reared), nymphs, exuviae. WILSON, Coal Creek: Aug. 12, 1940, T. H. Frison & T. H. Frison, Jr., 1 nymph.

I have studied a nymphal male in the collection of Cornell University collected at "Estes Park, Colo., Aug. 2, 1921," which was determined as "*P. expansa*" by Claassen. It is probable that this is one of the specimens he describes and records, with erroneous date citation, from "Estes Park, Col., Aug. 4, 1921," and states that "identification of this species was made possible by a study of the genitalia of both male and female nymphs." The genitalia of this male are well developed, but I cannot separate this specimen from similar well-developed nymphs which I am certain are *modesta*. It may be that *expansa* is a synonym of *modesta*.

It is possible that the nymph described, but not reared, by Claassen (1931) as *Perla expansa* Banks [now *Diploperla expansa* (Banks)] is of this species. This possibility is suggested because of the unidentate character of the lacinia.

Diploperla pilata new species

MALE. — General color yellowish to dark brown. Head and pronotum with dark and light areas forming a color pattern as in fig. 78. Legs, antennae and anal cerci yellowish brown. No gill remnants.

Head wider through compound eyes than width of pronotum; lateral ocelli slightly more removed from one another than from anterior ocellus, distance between them about twice the distance each is removed from inner edge of compound eye.

Pronotum approximately quadrangular, somewhat broader than long, angles rounded, a distinct pattern of raised rugosities on surface each side of median longitudinal stripe, fig. 78.

Legs with first and second tarsal segments together about one-third as long as third, first tarsal segment slightly longer than second.

Wings, fig. 78, essentially hyaline with venation dark brown; tip of wing with branches of radial sector slightly turned upwards; venation in general similar to that of wing figured for *Dictyopterygella knowltoni* Frison (1937).

Abdomen, fig. 78, with tenth tergite cleft for reception of narrow, elongate, supra-anal process, membranous on upper surface and sclerotized on lower surface, flanked on each side by a slender, sclerotized, lateral stylet (paragenital lobe); dorsal lobes on posterior margin of segment bordering cleft shaped as in fig. 78, with some short, stout spines. Seventh sternite, fig. 78, with a broad lobe extending slightly backwards, ninth sternite produced backwards over tenth sternite but not upturned over tenth sternite.

Length to tip of wings 16 mm.; length to tip of abdomen 13 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 78, with subgenital plate greatly produced so that it covers most of the ninth sternite, hind margin of plate not indented, sides somewhat rounded.

Holotype, male.—Vedder Crossing, B. C.: May 10–26, 1936, W. E. Ricker.

Allotype, female.—Same data as for holotype.

Paratypes. — BRITISH COLUMBIA. — VEDDER CROSSING: Same data as for holotype, 3 ♂, 17 ♀; Chilliwack River, April 24, 1937, S. Spencer, 1 ♂; May 9, 1937, Ricker & Spencer, 7 ♂, 3 ♀. SUMAS RIVER: May 4–6, 1937, W. E. Ricker, 2 ♀. CULTUS LAKE: May 10–26, 1937, W. E. Ricker, 1 ♂, 1 ♀; Chilliwack River, May 8–22, 1938, S. Spencer, 2 ♀.

OREGON.—DODGE PARK, at confluence of Sandy and Bull Run rivers: June 22, 1933, R. Dimick, 1 ♀. LACOMB, Crabtree County: June 4, 1935, R. Dimick, 1 ♂. CLACKAMAS COUNTY, Eagle Creek: June 20, 1935, S. G. Jewett, Jr., 8 ♀. FARMER'S RIVER: June 20, 1930, 1 ♀. PROSPECT: July 12, 1933, G. Hoppe, 1 ♀.

WASHINGTON.—GREEN RIVER GORGE: May 27, 1933, G. Hoppe, 1 ♂.

NYMPH. — General color yellowish brown with darker areas on head, thorax and abdomen, as in fig. 79. Antennae, legs and anal cerci mostly yellowish.

Head with three ocelli forming an almost equilateral triangle, lateral ocelli about as far apart as each is distant from inner edge of compound eye; no occipital ridge; basal segments of mouthparts conspicuously extending out laterally from the sides of head so that head appears much broader than thorax.

Labium, maxillae and mandibles as in fig. 78.

A small, nipple-like projection at each outer posterior corner of the submentum suggestive of an atrophied submental gill, fig. 78. No true submental gill.

Pronotum much broader than long; outer margins darkly outlined and central area mostly light colored, raised rugosities faint.

Abdominal tergites mostly yellowish brown with narrow, dark, transverse stripes prominent on anterior margins and weaker on posterior margins, fig. 79; tergites, except for posterior margins, mostly devoid of short, stout setae. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on dorsal surface in addition to smaller spinelike ones encircling apex of each segment.

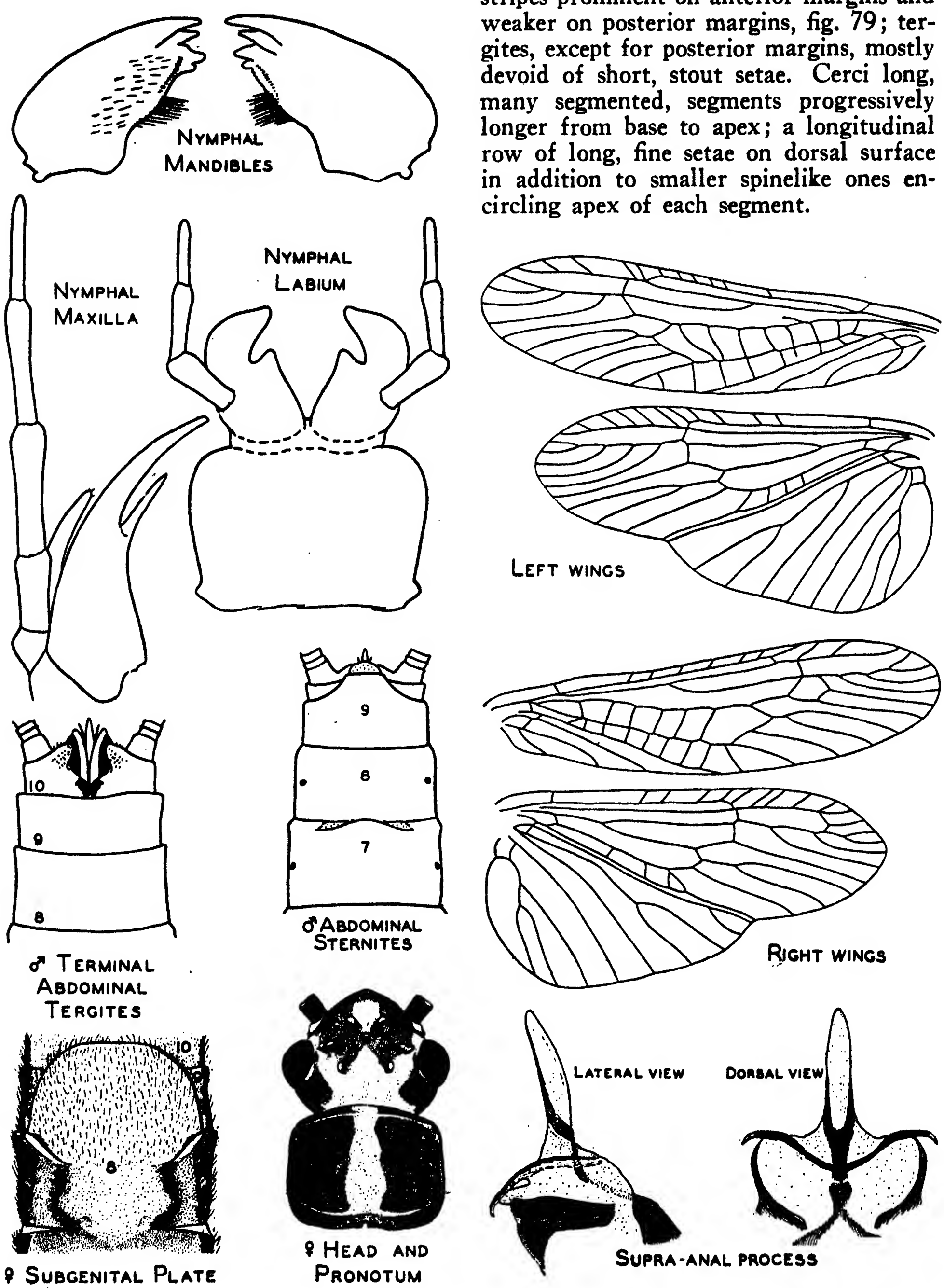


Fig. 78.—*Diploperla pilata.*

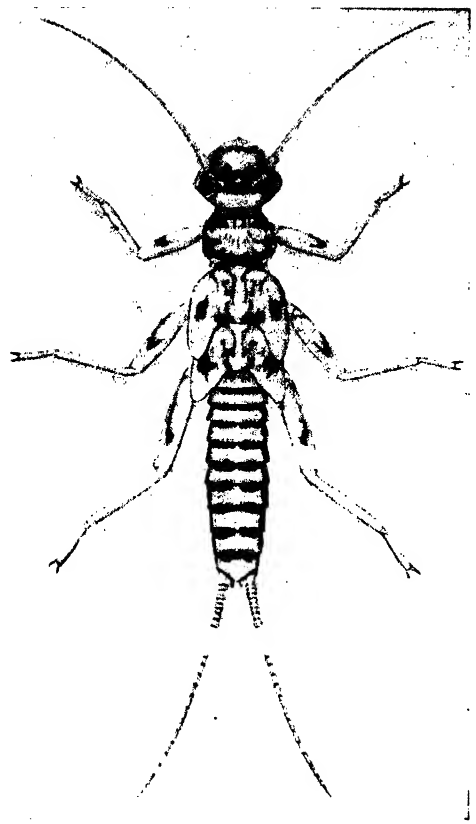


Fig. 79.—Nymph of *Diploperla pilata.*

Approximately mature specimens with a body length, exclusive of appendages, of 17 mm.

Nymphal and exuvial records are as follows: SUMAS RIVER, British Columbia, May 4–6, 1937, W. E. Ricker, 3 nymphs, 1 exuvia.

I am naming this species as new with considerable misgiving because of its close relationship with *Diploperla expansa* (Banks), described from Colorado; future collecting and studies may determine that they are synonymous. *D. expansa* is represented in the Illinois Natural History Survey collection by two females from separate localities in Colorado. These differ from the specimens here described as new in having a much larger and more quadrate subgenital plate; also, there are some differences in the color pattern on the head. Furthermore, Claassen (1931) described, but did not figure, the nymph of *expansa* as having the lacinia unidentate and similar to *D. bilobata* (Needham & Claassen). The nymphs described here, and which I am certain go with the adults here described, have the lacinia bidentate. If Claassen's association of the nymph with *expansa* is correct, then this proposed new species is certainly distinct. There is a possibility, however, since Claassen did not actually rear any specimens of *expansa* from the nymphs he describes, that nymphs he called *expansa* are *D. modesta* (Banks) or some other closely related species.

Diploperla bulbosa new species

MALE. — General color yellowish brown. Head and pronotum with dark and light areas forming an indistinct pattern, as in fig. 80. Legs and antennae in general concolorous with head and thorax; anal cerci with apical segments more yellowish. No gill remnants.

Head through compound eyes about as wide as pronotum; lateral ocelli slightly more removed from one another than from anterior ocellus, distance between each lateral ocellus and inner margin of compound eye about equal to distance between lateral ocelli.

Pronotum approximately quadrangular, somewhat broader than long, a pattern of raised rugosities on surface each side of rather indistinct, median, longitudinal, yellowish stripe, fig. 80.

Legs with first and second tarsal segments together about one-half as long as third, first tarsal segment slightly longer than second.

Wings with membrane and veins heavily stained with brown; venation of holotype as in fig. 80, but no doubt subject to some variation in a series of specimens.

Abdomen with segments normal through ninth; tenth tergite cleft, fig. 80, the lobes formed by this cleft raised upwards; supra-anal process erect and protruding with tip bulbous, inclosed at base by two weakly sclerotized lobes or membranous folds; without lateral stylets flanking supra-anal process; subanal lobes elongated, somewhat bulbous at tip and forming a back support for supra-anal process. Seventh sternite with a broad lobe on posterior margin; eighth sternite with slight indications of a lobe, accentuated by the more numerous concentration of hairs, fig. 80.

Length to tip of wings 14 mm.; length to tip of abdomen 18 mm.

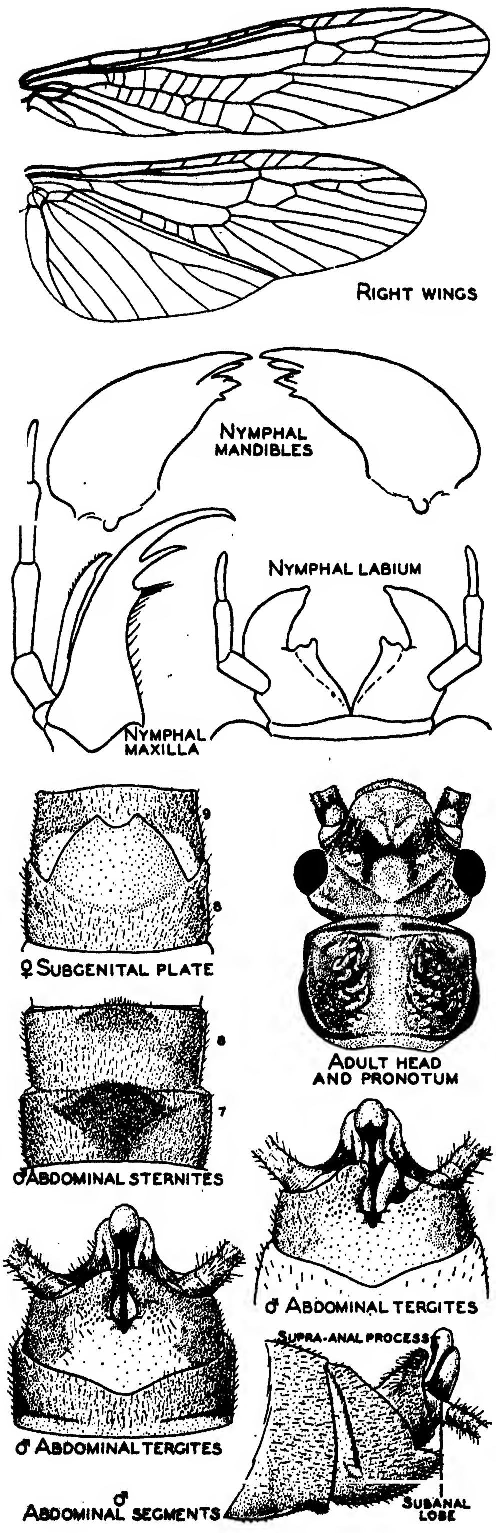


Fig. 80.—*Diploperla bulbosa.*

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male, but slightly larger in size. Important differences are as follows: Eighth abdominal sternite on posterior margin with a very large subgenital plate which covers most of the ninth sternite; median posterior margin of this plate is distinctly cleft, fig. 80.

Holotype, male.—Great Smoky Mountains National Park, Greenbrier Cove, Tenn.: June 4, 1939, A. C. Cole.

Allotype, female.—Same data as for holotype.

Paratypes.—TENNESSEE.—GATLINBURG: June 27, 1940, reared from nymph, T. H. Frison *et al.*, 1♀.

NYMPH. — General color yellowish brown with dark brown or fuscous areas on head, thorax and abdomen, as in fig. 81. Antennae, legs and anal cerci mostly yellowish brown.

Head with three ocelli forming an almost equilateral triangle, lateral ocelli slightly closer together than each ocellus is distant from inner margin of adjacent compound eye; no complete occipital ridge, but short, stout spinulae with conspicuous bases extend around posterior half of compound eye, and a row of them extends inwards part way to center from inner margin of each compound eye; basal segments of mouthparts extend out conspicuously from sides of head so that head appears much broader than pronotum. Labium, maxillae and mandibles as in fig. 80; glossae and paraglossae terminating in nipple-like structures.

Pronotum broader than long, posterior angles or corners more rounded than anterior angles, fig. 81.

Abdominal tergites with prominent, pale-colored spots surrounded by dark brown or fuscous, fig. 81. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on dorsal surface in addition to smaller spinelike ones encircling apex of each segment.

Approximately mature specimens with a body length, exclusive of appendages, of 14 mm.

A small nipple-like projection at each outer posterior corner of submentum is suggestive of an atrophied submental gill. No true submental gill.

Nymphal and exuvial records are as follows.

NORTH CAROLINA.—Small stream near NEWFOUND GAP, 3,560 feet elevation: May 28, 1934, T. H. Frison, 1 nymph. SMOKEMONT, Oconaluftee River: May 28, 1934, T. H. Frison, 2 exuviae. MACON COUNTY, Nantahala River: May 30, 1939, T. Howell, 1 nymph.

TENNESSEE.—GATLINBURG: June 13, 1940, T. H. Frison *et al.*, 1 nymph, 6 exuviae.

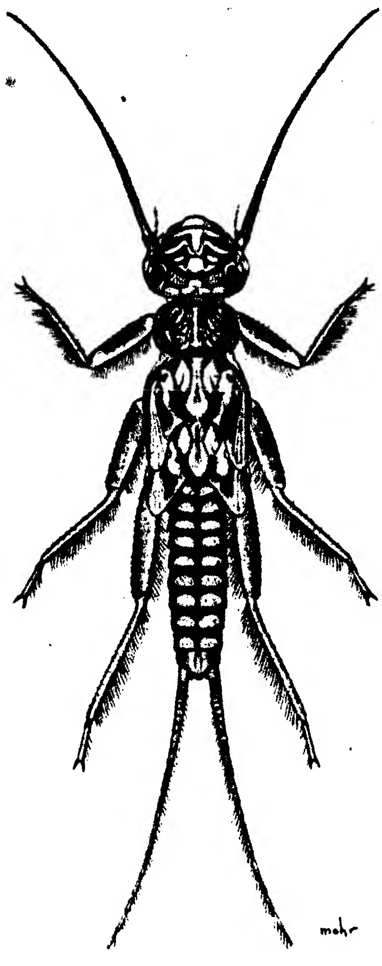


Fig. 81.—Nymph of *Diploperla bulbosa.*

This new species is close to the complex of species typified by *Diploperla hastata* (Banks). It differs from *hastata* in the male in the shape of the supra-anal process and the lack of lateral stylets or paragenital plates and in the female in the shape of the subgenital plate. The nymph is apt to be confused with the nymph of *hastata*, but the large light-colored areas on the abdominal tergites present in this new species are lacking in *hastata.*

Diploperla arina new species

MALE. — General color yellow and brown. Head and pronotum with brown and yellow areas forming a color pattern as in fig. 82. Legs yellow with brown markings; antennae and anal cerci yellowish brown. No gill remnants.

Head wider through compound eyes than width of pronotum; lateral ocelli slightly more removed from one another than from anterior ocellus, distance between them about the same as each is distant from inner margin of adjacent compound eye.

Pronotum approximately quadrangular,

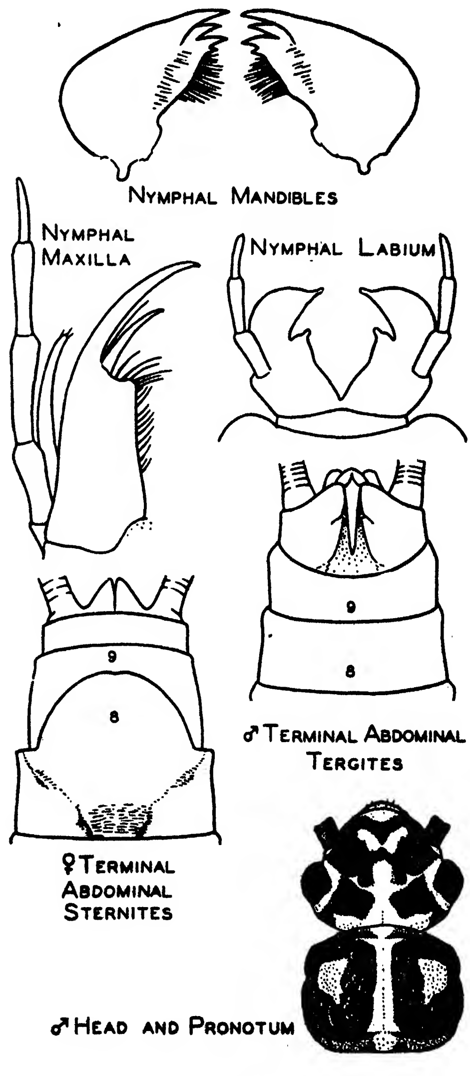


Fig. 82.—*Diploperla arina.*

somewhat broader than long, angles rounded; a distinct pattern of raised rugosities on surface each side of median, longi-

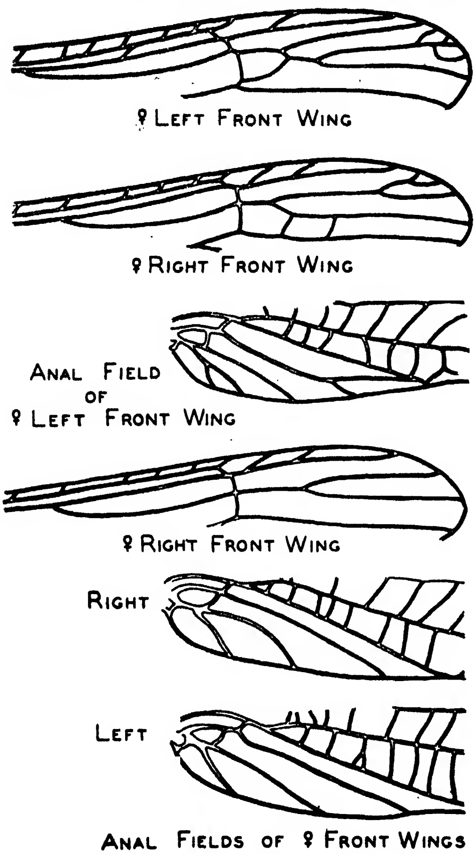


Fig. 83.—*Diploperla arina.*

tudinal, yellow stripe, stripe narrower at anterior margin than at posterior margin, fig. 82.

Legs with first and second tarsal segments together about one-half as long as third, first tarsal segment slightly longer than second.

Wings essentially hyaline with veins brown, venation variable as in fig. 83; slight suggestion of a brownish spot near inter-radial crossvein.

Abdomen, fig. 82, with segments normal through ninth; tenth tergite cleft, the lobes formed by this cleft broad and covered with numerous fine hairs and some small spinulae; inclosed within and beneath lobes is the supra-anal process, which is enveloped by two bulbous, weakly sclerotized lobes which in turn surround the membranous area from which the supra-anal process arises; the supra-anal process is very long, slender and tapers to a point; no lateral stylets are present; seventh and eighth sternites without well-developed lobes on posterior margins.

Length to tip of wings 21 mm.; length to tip of abdomen 17 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 82, with subgenital plate broad and greatly produced so that it covers most of ninth sternite, posterior margin of plate in middle very slightly notched.

Holotype, male.—Balsam, N. C., April 24, 1938, H. H. Ross & B. D. Burks.

Allotype, female.—Same data as for holotype.

Paratypes. — NORTH CAROLINA. — BALSAM: Same data as for holotype, 2♀.

TENNESSEE.—Greenbrier Cove, GREAT SMOKY MOUNTAINS NATIONAL PARK: May 7, 1939, A. C. Cole, 1♂.

NYMPH. — General color yellowish brown with dark brown or fuscous areas on head, thorax and abdomen, as in fig. 84. Antennae, legs and anal cerci mostly yellowish brown.

Head with three ocelli forming an almost equilateral triangle, lateral ocelli about as far apart as each is distant from inner margin of adjacent compound eye; no complete occipital ridge, although there is an indication of such a ridge each side of head running to compound eye; basal segments of mouthparts conspicuously extending out laterally from sides of head so that head appears much broader than pronotum. Labium, maxillae and mandibles as in fig. 82; glossae and paraglossae terminating in a small nipple-like structure.

Pronotum broader than long, corners rounded, fig. 84.

Abdominal tergites basically yellow with narrow, dark brown or fuscous transverse bands on anterior and posterior margins of tergites, fig. 84. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on dorsal surface in addition to smaller spinelike ones encircling apex of each segment.

Mature specimens with a body length, exclusive of appendages, of 19 mm.

A minute, nipple-like projection at each

outer posterior corner of the submentum is suggestive of an atrophied submental gill. No true submental gill.

Nymphal and exuvial records are as follows.

NORTH CAROLINA.—BALSAM: Same data as for holotype, 4 nymphs, 9 exuviae. WILLETTS: March 23, 1940, T. H. Frison, C. O. Mohr & A. S. Hawkins, 6 nymphs.

TENNESSEE.—ELKMONT, Little River: May 14, 1939, T. H. Frison & H. H. Ross, 9 exuviae. GATLINBURG, Le Conte Creek: May 14, 1939, T. H. Frison & H. H. Ross, 2 exuviae.

I have been able to associate the nymph of this species with its adult because of a mature male nymph which clearly shows the distinctive structural features of the adult about to emerge and which was collected at the same time and place as the holotype. The terminal abdominal structures of the male are much different from those of any other species of this genus known to me. Among the *Diploperla* (*s.l.*), as I am now recognizing this genus, this new species differs from *duplicata* (Banks) and *bilobata* (Needham & Claassen) in the male in lacking the lobes on terminal abdominal sternites. It differs from another complex of species, including *verticalis* (Banks), in lacking the heavily sclerotized lateral stylets flanking the supra-anal process.

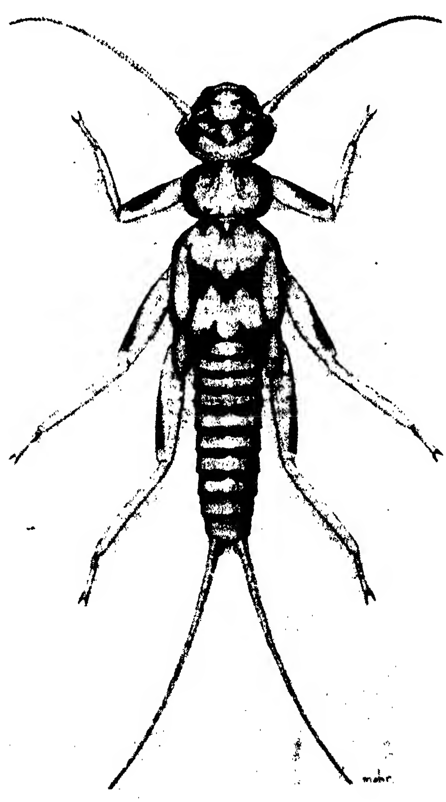


Fig. 84.—Nymph of *Diploperla arina.*

ISOPERLIDAE

The family placement of the genus *Isoperla* presents several problems. Needham & Claassen (1925), following many other workers, have placed this genus in the family Perlidae, and there are several reasons for so doing. In my 1935*a* paper on Illinois stoneflies, I placed *Isoperla* in the family Chloroperlidae, chiefly because of its lack of gills in nymphs or of gill remnants in adults. In addition to having characters in common with the Perlidae, the genus *Isoperla* (*s.l.*) has characters also in common with the Perlodidae.

It now seems desirable to me to erect a special family for this genus, rather than place it in existing families. Therefore, I propose the family name of Isoperlidae for the species now recorded under *Isoperla* (*s.l.*) and consider *bilineata* (Say), the type of the genus *Isoperla* Banks, as its most typical species.

Isoperla holochlora (Klapálek)

Chloroperla holochlora Klapálek (1923*b*, p. 23).

Probably because of its late date of description, *holochlora* was not included by Needham & Claassen (1925) in their *Monograph*; it was omitted by Claassen (1928) when additions and corrections to the *Monograph* were published. It is listed, however, in Claassen's (1940) posthumously published *Catalogue*.

Ricker (1938) in reporting upon his studies of the four cotypic series in the Musée Royal d'Histoire Naturelle, Brussels, Belgium, stated that one of these cotypic specimens is probably different from the others and selected a female as a lectotype. In 1938, through the kindness of Dr. Victor Van Straelen, Director of this Museum, one of the male cotypes, which Ricker assumed to be of the same species as the lectotypic female, was sent to me for study. This male agrees well with Ricker's description of the general features of the lectotypic female and was found to

be identical with specimens in the Illinois Natural History Survey collection from Tennessee and North Carolina.

Except for Ricker's drawing showing the triangular-shaped subgenital plate of

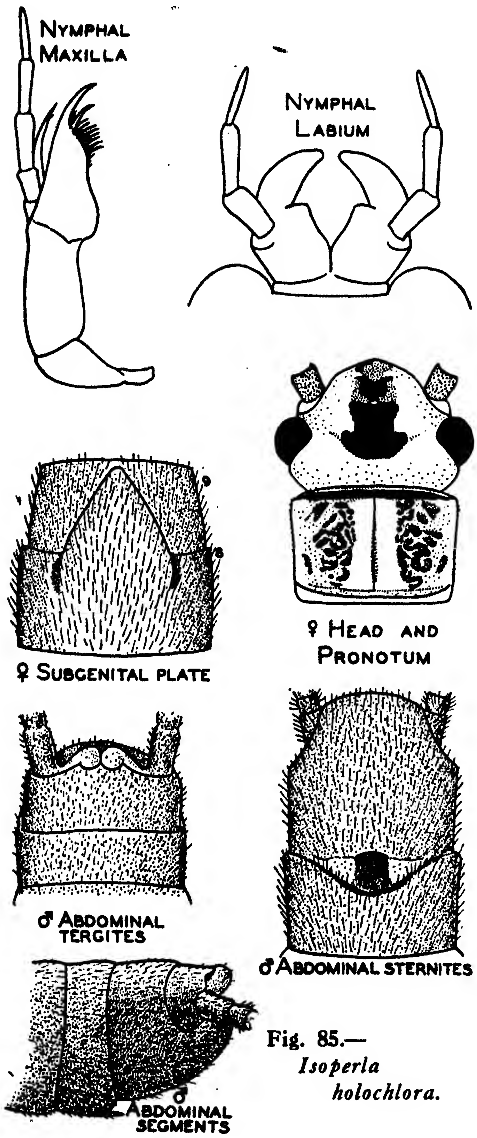


Fig. 85.—*Isoperla holochlora.*

the lectotypic female, no illustrations of this species have been published, and no records other than that of "Georgia" associated with the types have been introduced into literature.

Illinois Natural History Survey field work, as well as the study of some material submitted for identification, has revealed the presence of this species in several eastern states. Rearings have enabled me to associate the previously unknown nymph with its adult and definitely to establish the correct association of males with females. To facilitate future identifications of this species, illustrations of the important characters of the adults, fig. 85, are given and a description of the nymph is presented.

NYMPH.—General structural features approximately the same as for nymph of *Isoperla patricia*, described in this paper. Labium and maxillae as in fig. 85. General color pattern as in fig. 86, with tendency in some specimens for a broad, pale, longitudinal medial area on abdominal tergites to be more obscured.

Records for this species, based upon Illinois Natural History Survey field collecting and specimens submitted for identification, are as follows.

MAINE.—MOUNT KATAHDIN, Roaring Brooks: Aug. 26, 1939, T. H. Frison & T. H. Frison, Jr., 9♂, 21♀.

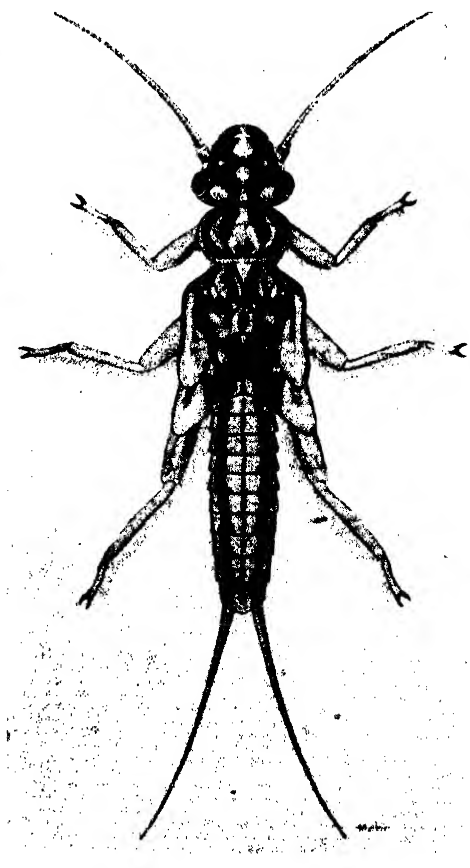


Fig. 86.—Nymph of *Isoperla holochlora.*

New York.—Cold Brook: June 30, 1940, H. Dietrich, 1♂.

North Carolina.—Balsam: April 24, 1938, Ross & Burks, 4 nymphs. Cherokee: June 26, 1938, W. Stehr, 1♂. Dillsboro: April 24, 1938, Ross & Burks, 1♂. Hazelwood: April 24, 1938, Ross & Burks, 1♂. Newfound Gap, elevation 3,560 feet: May 28, 1934, T. H. Frison, 2♂, 2♀. Smokemont, Oconaluftee Creek: May 28, 1934, T. H. Frison, 1♀, nymphs.

Pennsylvania. — Monroe County, Marshall's Creek: June 1, 1935, W. J. Harmer, A.N.S. Lot 862, 1♂ with exuvia (reared). Swiftwater, Monroe County: 1928, F. R. Nevin, Lot 258, 1♂, 4♀.

Tennessee.—Cades Cove: June 13, 1940, T. H. Frison *et al.*, 2♀ with exuviae (reared), 1♂, nymphs. Elkmont: fork of Little Pigeon River, May 27, 1934, T. H. Frison, 1 nymph; June 12, 1935, H. H. Ross, 5♂, 5♀; Little River, June 12, 1938, T. H. Frison & T. H. Frison, Jr., 1♂; same except June 17, 11 nymphs, 1 exuvia. Gatlinburg: Fighting Creek branch of Little Pigeon River, May 27, 1934, T. H. Frison, 4♂, 3♀, nymphs, exuviae; Little Pigeon River, June 12, 1935, H. H. Ross, 5♂, 1♀, 1♀ with exuvia (reared); Le Conte Creek, June 13, 1938, T. H. Frison & T. H. Frison, Jr., 4 nymphs, 1 exuvia; same except June 14, 1♂ with exuvia (reared); same except June 16, 2♂, 1♀, 3 nymphs; May 14, 1939, Frison & Ross, 8 nymphs; same except Le Conte Creek, 3♀, nymphs; same except Fighting Creek Gap, May 15, 2♂, 1♀; June 13, 1940, T. H. Frison *et al.*, nymphs; same except Pigeon River, June 14, 2♂, 3♀, 5 nymphs; June 14, 1940, T. H. Frison *et al.*, 1♂ and 1♀ with exuviae (reared), 1♂; same except June 16, 1♂ with exuvia (reared); same except June 19, 1♂ and 1♀ with exuviae (reared); same except June 20, 1♀ with exuvia (reared); same except June 25, 2♀ with exuviae (reared). Monteagle: April 26, 1938, Ross & Burks, 2♂ (compared with paratype). Great Smoky Mountains National Park: Greenbrier Cove, 2,400 feet elevation, July 19, 1939, A. C. Cole, 1♀; Chimneys Camp Grounds, July 13, 1939, A. C. Cole, 1♂.

Virginia.—Big Meadows, Shenandoah National Park: April 20, 1938, Ross & Burks, 5 nymphs.

Isoperla patricia new species

Male. — Basic color light yellowish brown, with darker markings forming a distinct pattern on head and pronotum, fig. 87; posterior half of mesothorax and metathorax dark brown; in life, and sometimes in fresh material, the abdomen is colored vermilion. Legs, antennae and anal cerci pale yellowish brown. No gill remnants.

Head slightly wider through compound eyes than width of pronotum; lateral and median ocelli forming an approximately

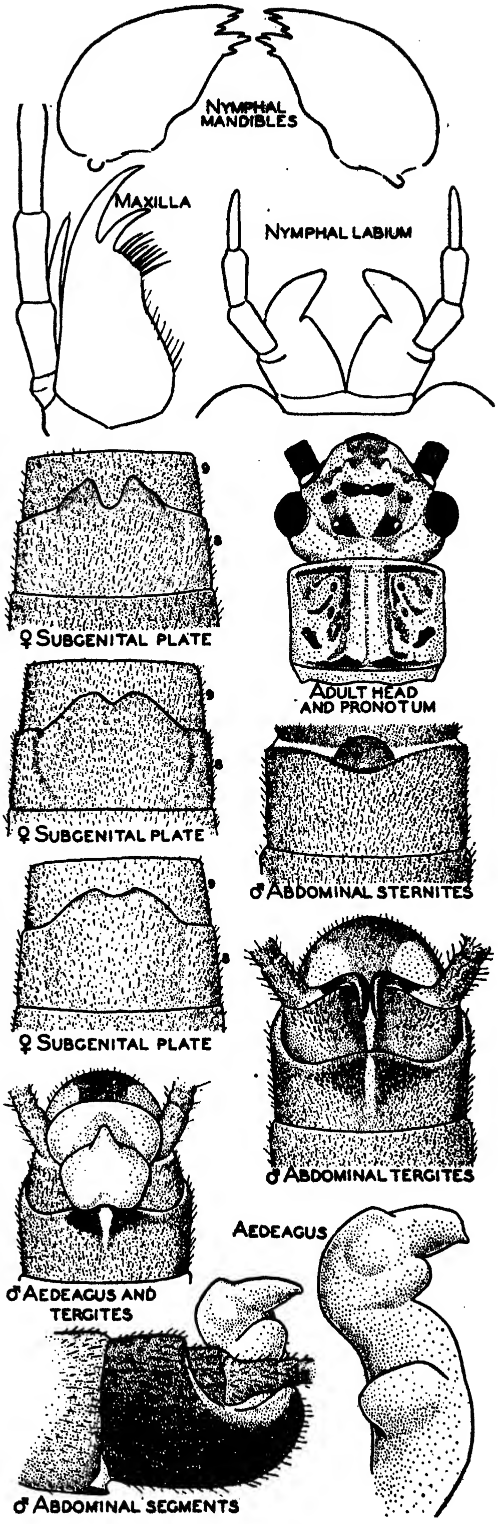


Fig. 87.—*Isoperla patricia.*

equilateral triangle, distance between ocelli about the same as each lateral ocellus is removed from compound eye.

Pronotum approximately quadrangular, broader than long, a distinct pattern of raised rugosities on surface each side of pale, median, longitudinal stripe, with posterior end of stripe broader than anterior end, fig. 87.

Legs with first and second tarsal segments together shorter than third, first tarsal segment longer than second.

Wings hyaline with costal margins pale yellowish, venation light brown.

Abdomen, fig. 87, with tenth tergite not cleft but with a distinct, depressed, median, longitudinal trough almost free of stout setae and separating flanking patches of numerous short, stout setae; subanal lobes recurved upwards over tenth tergite and with prominent, slender, long, sharply pointed tips; aedeagus membranous with distinctive shape, fig. 87; ninth sternite produced much beyond tip of abdomen and rounded behind; eighth sternite with a prominent median lobe on posterior margin, fig. 87.

Length to tip of wings 10 mm.; length to tip of abdomen 9 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 87, with subgenital plate partly produced over ninth sternite and deeply notched in most specimens but occasionally only slightly indented.

Holotype, male.—Spearfish, Spearfish River, S. D.: July 27, 1940, T. H. Frison & T. H. Frison, Jr.

Allotype, female.—Same data as for holotype.

Paratypes. — SOUTH DAKOTA. — SPEARFISH: Same data as for holotype, 45♂, 20♀.

BRITISH COLUMBIA.—VANCOUVER: July 25, 1936, H. H. Ross, 1♀.

CALIFORNIA.—MONO COUNTY, Convict Creek: July 3, 1938, H. J. Rayner, 2♀.

COLORADO.—HARTZEL: July 22, 1938, H. H. & J. A. Ross, 1♀. IOLA: June 22, 1934, elevation 7,450 feet, H. Pratt, 2♂. ECKERT, Surface Creek: June 28, 1938, Lanham & Bauer, 2♀. GRANBY, Colorado River: July 24, 1938, H. H. & J. A. Ross, 3♂. LAKE GEORGE, South Platte River: July 22, 1938, H. H. & J. A. Ross, 1♀.

IDAHO.—ST. ANTHONY: June 28, 1938, H. S. Telford, 1♀.

MONTANA.—HARRISON: July 8, 1936, H. H. Ross, 1♀. TOSTON, Missouri River: June 22, 1940, H. H. & J. A. Ross, 15♂, 15♀. NOXON, Clark Fork River: June 23, 1940, H. H. & J. A. Ross, 1♂.

OREGON. — FRENCHGLEN, Harney County, Blitzen River: July 11, 1935, S. G. Jewett, Jr., 1♂. Five miles south of UNION CREEK on Mill Creek: June 24, 1937, S. G. Jewett, Jr., 1♂. FORT KLAMATH: June 26, 1937, S. G. Jewett, Jr., 3♂, 1♀. WILLAMETTE RIVER: May 26, 1938, C. Jensen, 1♂, 1♀. Near mouth of WILLIAMSON RIVER, July 8, 1938, R. Dimick, 1♀.

UTAH.—OGDEN CANYON: June 21, 1937, O. E. Hardy, 1♀; June 23, 1938, Hardy & Stains, 1♂. BLACKSMITH FORK CANYON: June 20, 1937, Harmston & Smith, 8♂, 6♀. HUNTSVILLE; June 23, 1938, Hardy & Stains, 1♀; June 27, 1937, G. F. Knowlton, 1♀. SUNSET: July 26, 1933, G. F. Knowlton, 1♀. PARADISE: June 14, 1938, Hardy & Stains, 14♂, 12♀. KANOSH CANYON: May 27, 1939, Knowlton & Harmston, 1♂, 3♀. EDEN: July 15, 1938, G. F. Knowlton, 1♀. UINTA: June 18, 1937, G. F. Knowlton, 2♂, 2♀. LOGAN CANYON: July 11, 1938, D. E. & A. T. Hardy, 1♀. SMITHFIELD: May 13, 1939, Knowlton & Harmston, 2♀.

WYOMING. — BOULDER, Tributary of Pine Branch: July 6, 1936, H. H. Ross, 3♂, 2♀. PINEDALE, Green River: July 6, 1936, H. H. Ross, 1♀. CENTENNIAL: July 2, 1938, D. J. & J. N. Knull, 1♀.

NYMPH.—General color pale yellowish with darker areas on head, thorax and abdomen, as in figs. 88 and 89; specimens exhibit color variation from a light, fig. 88, to dark, fig. 89, phase; nymphal male in life sometimes shows reddish abdominal coloring as in adult. Antennae, legs and anal cerci mostly yellowish.

Head with three ocelli forming an almost equilateral triangle, lateral ocelli about as far apart as each is distant from inner edge of compound eye; no occipital ridge; basal segments of mouthparts not extending out from side of head. Labium, maxillae and mandibles as in fig. 87.

Pronotum broader than long, with markings as in figs. 88 and 89.

Abdominal tergites with general background yellowish and with dark longitudinal stripes as in figs. 88 and 89; some scattered, stout, short setae on abdominal tergites in addition to row on posterior margin of each tergite. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on dorsal surface of apical segments in addition to smaller spinelike ones encircling apex of each segment.

Approximately mature specimens with body lengths, exclusive of appendages, in males 11 mm. and in females 12 mm.

No thoracic, anal or submental gills.

Nymphal and exuvial records: same data as for holotype, 22 nymphs, 13 exuviae.

I am naming this species in honor of my daughter, Patricia Ann, who takes great delight in assisting with the collection of stonefly adults and nymphs whenever opportunity presents itself and who helped with the collection of the nymph and adult specimens from Spearfish, S. D.

This widely distributed western species is easily recognized in the female among species of *Isoperla*, because of its usually distinctly notched subgenital plate and the peculiar darkening of the posterior part of the mesothorax and metathorax. *Isoperla fulva* Claassen (1937*d*) has somewhat the same general color appearance, but the subgenital plate of the female is quite different, and the subanal lobes of the male are much shorter and stouter.

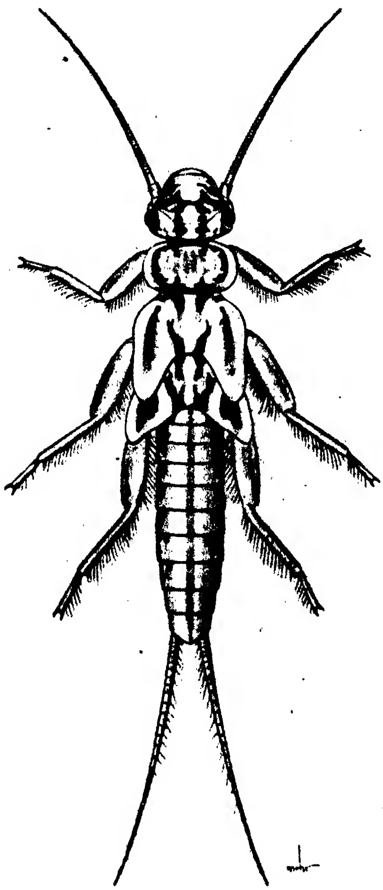


Fig. 88.—Nymph of *Isoperla patricia*, light form.

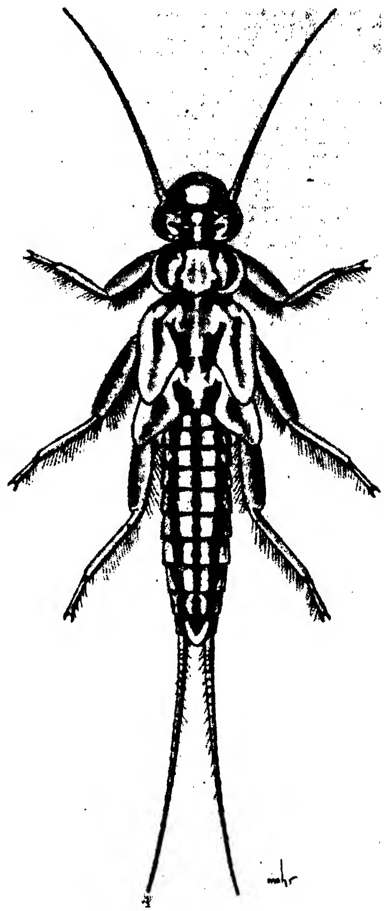


Fig. 89.—Nymph of *Isoperla patricia*, dark form.

I. extensa Claassen (1937*d*) has a subgenital plate suggestive of *patricia*, but in *extensa* this structure is broader at base and its general make-up is more similar to that of *bilineata* (Say).

Although the adult was not actually reared from the nymph, the circumstances under which nymphs, exuviae and adults were taken at Spearfish, S. D., on July 27, 1940, have enabled me with certainty to associate immature and adult forms. The vermilion coloring of the abdomen of some adult males and indications of this coloring in some nymphal males are most unusual in this order of insects.

Isoperla transmarina (Newman)

Chloroperla transmarina Newman (1838*b*, p. 499). Original description, ♀.
Isoperla ventralis Banks (1908*b*, p. 66). Original description, ♂, ♀. New synonymy.

Isoperla transmarina was synonymized by Hagen in 1861 as the same as *bilineata* (Say), but Ricker (1938) has clearly shown that it is not *bilineata*. Ricker's drawings of the color pattern of the head and of the subgenital plate are so characteristic of *ventralis* that I have no hesitancy in placing *ventralis* as a synonym of *transmarina*.

Newman's original description is not clear as to sexes involved, but according to Ricker the typic specimen now in the British Museum is a female. "Inhabits Canada, etc." and "Trenton Falls" indicate in the original description the source of the typic specimen, and the specimen considered as the type by Ricker is from "North America." The statements regarding locality of typic specimen fit the general northeastern range of the species described by Banks (1908*b*) as *ventralis* and now synonymized as *transmarina*.

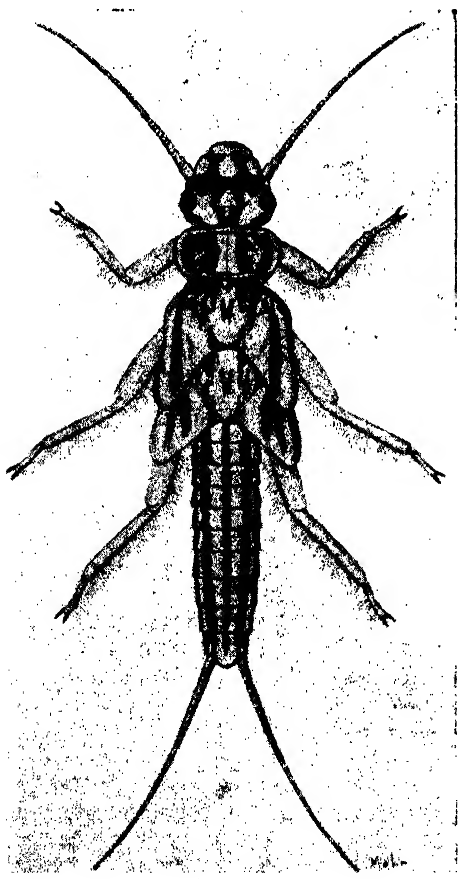


Fig. 90.—Nymph of *Isoperla transmarina*.

Isoperla ventralis was described from specimens collected at "Grand Lake, Newfoundland," and the typic series is now in the collection of the Museum of Comparative Zoology (No. 11,333). In the original description, reference is made to both males and females, but the typic series now contains only males. Evidently a similar situation existed when Claassen studied the types, because Needham & Claassen (1925) omit any reference to the female.

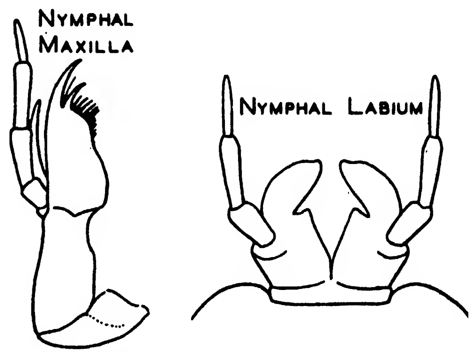


Fig. 91.—*Isoperla transmarina*.

Through the kindness of Dr. Nathan Banks, I was permitted to relax one of the typic males and study it closely in comparison with reared specimens. It seems advisable to designate this particular specimen as the **lectotype** and I so do.

The rearing of adult males and females has enabled me to associate conclusively the heretofore undescribed nymph of this species, and the description of the nymph is therefore presented.

NYMPH.—General color yellowish with darker areas forming a conspicuous pattern on dorsum of head, thorax and abdomen, fig. 90. Antennae, legs and anal cerci mostly yellowish.

Head with three ocelli forming an almost equilateral triangle, lateral ocelli about as far apart as each is distant from inner edge of compound eye; no occipital ridge; basal segments of mouthparts not extending out from sides of head. Labium and maxillae as in fig. 91.

Pronotum much broader than long with

markings as in fig. 90, corners rounded.

Abdominal tergites with alternating longitudinal stripes of yellow and brown, fig. 90. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on apical segments in addition to smaller spinelike ones encircling apex of each segment.

Mature specimens with a body length, exclusive of appendages, up to 14 mm.

No gills present.

Since this species has been previously recorded only in the original descriptions already noted, I present the following records, which show it has a wide northeastern distribution in North America.

MANITOBA.—CHURCHILL: July 5–9, 1936, H. E. McClure, 5♂, 3♀; July 23, 1936, H. E. McClure, 1♂. SWAN RIVER, Swan River: June 5, 1936, H. E. McClure, 1♂, 2♀, 4 nymphs.

MICHIGAN.—BALDWIN, Pere Marquette River: May 28, 1939, Frison & Ross, 1♂; May 9, 1940, Frison & Ross, 1♂, 5♀ with exuviae (reared); same except May 9–10, ♂♂, ♀♀, nymphs, exuviae; same except May 10, 1♂, 1♀ with exuviae (reared). Boardman River, 3 miles above TRAVERSE CITY power dam: March 7, 1935, J. W. Leonard, nymphs and 1 exuvia. GERMFASK, Manistique River: May 11, 1940, Frison & Ross, 4 nymphs. GRAND TRAVERSE COUNTY, Boardman River: May 7, 1935, J. W. Leonard, ♂♂, ♀♀. HONOR, Platte River: May 27, 1939, Frison & Ross, 3♂, 4♀, 2 nymphs with exuviae and 1♂ with exuvia (reared); May 10, 1940, Frison & Ross, 2♂, 6 nymphs, 1 exuvia. LAKE COUNTY, Pine River: May 14, 1938, O. H. Clark, 1♀; May 16, 1938, O. H. Clark, 2♀; Walker Bridge Camp, May 29, 1938, J. W. Leonard, 1♂, 2♀; May 30, 1938, O. H. Clark, 1♀; Walker Bridge Camp, at light, May 31, 1938, O. H. Clark, 3♂, 1♀; June 4, 1938, J. Blue, 1♂, 1♀; June 11, 1938, R. Love, 1♀; June 12, 1938, J. Blue, 3♀. LUZERNE, east branch of Big Creek: J. W. Leonard, 1 exuvia. MAYFIELD, Boardman River: May 28, 1939, Frison & Ross, 1♀. MONTMORENCY COUNTY, Hunt Creek: April 14, 1939, J. W. Leonard, 2 nymphs. Route 46 between MUSKEGON and KENT CITY, tributary of Black Creek: May 9, 1940, Frison & Ross, 1♂ with exuvia (reared), 5 nymphs. NAHMA JUNCTION, Sturgeon River: May 12, 1940, Frison & Ross, nymphs; same data except May 15, 2♀ with exuviae (reared); same data except May 17, 1♀ (reared); same data except May 20, 2♀ with exuviae (reared). NIRVANA, Sanborn Creek: May 10, 1940, Frison & Ross, 4 nymphs. OTSEGO COUNTY, west branch of Sturgeon River: March 15, 1935, J. W. Leonard, 3 nymphs. PEACOCK, Little Manistee River near town: May 10, 1940, Frison & Ross, 3♂, 2♀, nymphs, 1 exuvia. Sturgeon River, west branch between VANDERBILT and WOLVERINE: March 15, 1935, J. W. Leonard, 1 nymph. THOMPSON, creek near town: May 12, 1940, Frison & Ross, 2 nymphs.

MINNESOTA. — WINONA COUNTY: May 20, 1938, Page Nicholson, 1♀.

ONTARIO.—ALGONQUIN PARK, Costello Lake, Ontario Fisheries Research Laboratory: June 14, 1938, W. M. Sprules, 1♀. KENORA: June 16, 1908, 1♀.

WISCONSIN.—BOULDER JUNCTION: Trout River, July 3–4, 1933, Frison & Mohr, exuviae; Trout River, June 20, 1934, Frison & Mohr, 4 exuviae; Trout River, April 8–9, 1937, Frison & Mohr, 1 nymph; May 6–17, 1937, Frison & Mohr, 5 nymphs; May 7–17, 1937, Frison & Mohr, 12♂, 15♀ (reared); May 20, 1937, Frison & Mohr, 2 nymphs. SPOONER, Namakagon River: June 6, 1936, Frison & Ross, 2 exuviae.

Isoperla fusca Needham & Claassen

Isoperla fusca Needham & Claassen (1925, p. 146). Original description, ♂, ♀.

Specimens of this species, recorded only once (Neave 1929) since it was first described from specimens collected at Waterton Lakes, Alberta, Canada, were found

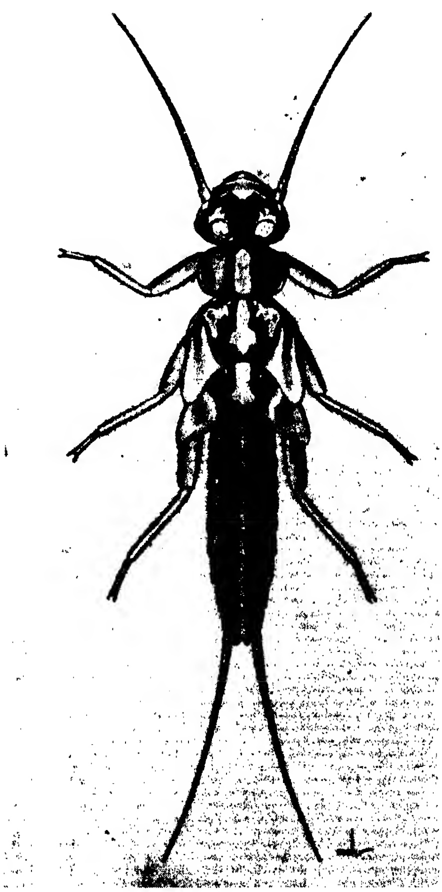


Fig. 92.—Nymph of *Isoperla fusca*.

by the writer in a small stream at Dunraven Pass, Mount Washburn, Yellowstone National Park, Wyo., Aug. 2, 1940. In addition to five male and two female adults, two nymphs and one exuvia were collected under such conditions that I am certain these immature forms belong with the adults. A nymph is shown in fig. 92.

The adults agree very well with the original description and a dissection of the apical abdominal sternite of one male revealed the forked chitinous process of the aedeagus which is so characteristic of this species and was illustrated by Needham & Claassen. Several illustrations of important structures of the male and female are presented to aid future recognition of this little known species, fig. 93.

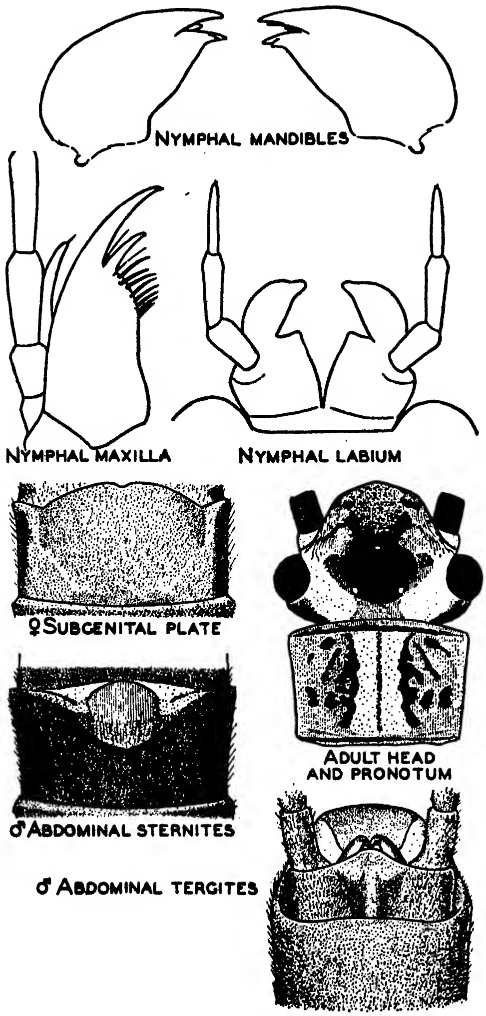


Fig. 93.—*Isoperla fusca.*

Since the nymph has not been previously recognized, a description and illustration of it are presented here.

NYMPH. — General color brown with lighter areas as in fig. 92. Legs, antennae, anal cerci and ventral parts of body pale yellow. Short, stout, spinelike setae, in addition to longer hairs, present on body and particularly femora. Ocelli in same relative position as in adult. Basal segments of mouthparts not extending noticeably from the sides of the head. Labium, maxillae and mandibles as in fig. 93.

Pronotum broader than long with a pale yellow longitudinal stripe in middle, fig. 93.

Abdominal tergites mostly dark brown, but a pale median longitudinal stripe is present, and a lateral flanking stripe on each side is slightly in evidence.

Cerci long, many segmented, segments progressively longer from base to apex; small, stout, spinelike setae encircling apex of each segment, but with no evidence of long, fine setae on dorsal surface of apical segments as in some species.

Approximately mature specimens with a body length of 10 mm.

No thoracic, anal or submental gills.

Nymphal specimens collected at same time and place as adults.

Isoperla longiseta Banks

Isoperla longiseta Banks (1906c, p. 337). Original description, ♀.

Isoperla longiseta is a species apparently associated with the prairie and plain states mostly west of the Mississippi River and partially replaced in the Rocky Mountain and perhaps entirely in the West Coast states by *mormona* Banks. The collection of specimens of this species in Missouri by Dr. H. H. Ross in 1937 and the determination as this species of material from Ames, Iowa, in 1935, indicated it might some day be found in western Illinois. This supposition was confirmed in 1939 by the capture in extreme western Illinois, on the Mississippi River at Quincy, of a single female of this species. I am inclined to believe that the record of *longiseta* from "Indiana" by Needham & Claassen (1925) was in error.

The two typic females, No. 11,336, in the collection of the Museum of Comparative Zoology, have been studied and com-

pared with similar specimens in the Illinois Natural History Survey collection. In many respects *longiseta* is closely related to *mormona.* The only characters which I have been able to locate to separate these two species are as follows: (1) in the male of *longiseta* the lobe on the posterior margin of the eighth abdominal sternite is rounded, figs. 94 and 95, and the subanal lobes at the tip of the abdomen are long and slender; whereas in the male of *mormona* the lobe is more distinctly truncated or square and the subanal lobes are shorter and somewhat stouter; (2) in the female of *longiseta* the subgenital plate, figs. 94 and 95, is much produced, rounded and strongly sclerotized, whereas in the female of *mormona* it is much less produced and more weakly sclerotized; (3) in *longiseta*, both sexes, the pronotum has dark brown embossings that are more or less strongly contrasting in color with the remainder of the pronotum, figs. 94 and 95, whereas in *mormona* the entire area, except for the median yellowish stripe, is more uniformly suffused with brown.

In the Illinois Natural History Survey collection is a series of males, females and exuviae from El Paso, Tex., which I am identifying with some hesitation as *longiseta.* All of the males of this series are brachypterous, fig. 96. Compared with *longiseta* specimens from Illinois and other states, fig. 95, these Texas specimens have the dark area on the dorsum of the head anterior to the ocelli more suffused, fig. 94, and the modified subanal lobes appear shorter and stouter and in this respect

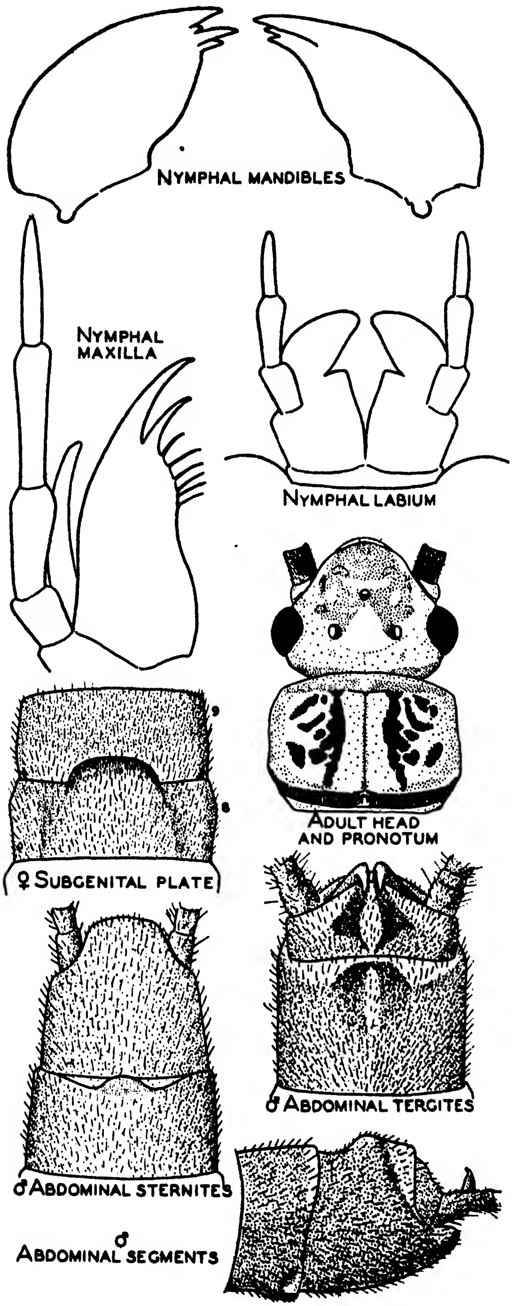


Fig. 94.—*Isoperla longiseta*, drawn from Texas specimens.

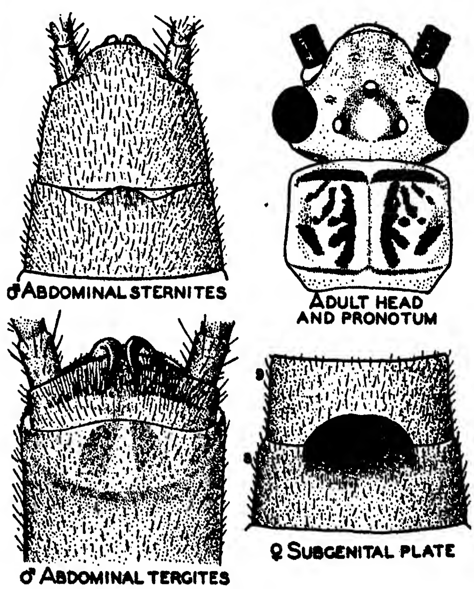


Fig. 95.—*Isoperla longiseta*, drawn from Mississippi River valley specimens.

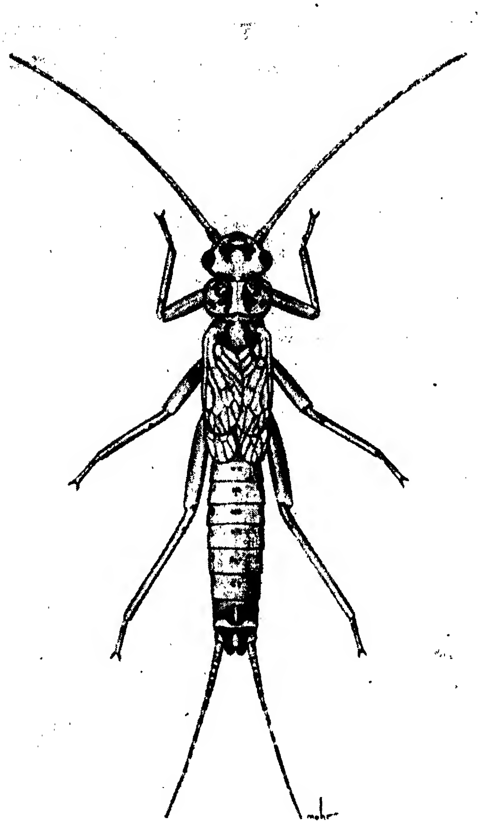


Fig. 96.—*Isoperla longiseta,* adult male from Texas.

more like *mormona.* The other characters of these Texas specimens, and, particularly, the shape of the subgenital plate of the female, strongly support, however, their specific identity with *longiseta.* The Illinois Natural History Survey collection also contains a single male from "La Veta Pass, Colorado," which apparently agrees with the Texas specimens in every way.

The nymph of this Texas race, as I now consider it, of *longiseta* is typical of the *Isoperla* group or complex containing the species *bilineata* (Say). Fig. 94 shows the shape of the mandibles, maxillae and labium, and fig. 97 is a dorsal view of the nymph, all drawn from exuviae. The nymph of typical *longiseta* from other states has not been described or illustrated, and when found it should help clear up the status of these Texas specimens.

Distributional records for *longiseta* based upon specimens in the Illinois Natural History Survey collection, or submitted for identification, are as follows.

ILLINOIS.—QUINCY: June 8, 1939, Burks & Riegel, 1♀.

COLORADO.—LA VETA PASS: July 21, 1938, D. J. & J. N. Knull, 1♂ (brachypterous).

IOWA.—AMES: May 30, 1929, 1♂, 1♀; June 1, 1929, 2♀; June 3, 1929, 3♂, 1♀; June 10, 1931, P. A. Moore, 3♀.

MINNESOTA.—ST. PAUL, University Farm at light: June 16, 1933, A. A. Granovsky, 1♀.

MISSOURI.—JEFFERSON CITY: May 29, 1937, H. H. Ross, 1♂, 1♀.

MONTANA. — GLENDIVE, Yellowstone River: July 14, 1940, J. A. & H. H. Ross, 3♂, 7♀.

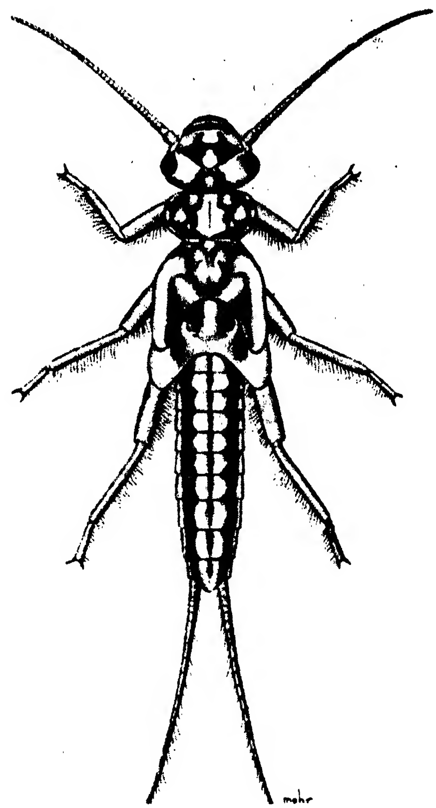


Fig. 97.—*Isoperla longiseta* nymph, drawn from exuviae collected in Texas.

LOHMAN, Milk River: July 13, 1940, J. A. & H. H. Ross, 2♀. WOLF POINT, Missouri River: July 14, 1940, J. A. & H. H. Ross, 2♂, 9♀.

SOUTH DAKOTA.—BROOKINGS: 1♀; June 6, 1919, H. C. Severin, 1♂. BUFFALO: June 19, 1925, H. C. Severin, 1♂, 1♀. CHAMBERLAIN, Missouri River: June 19, 1940, J. A. & H. H. Ross, 6♂, 3♀. GRASS ROPE: June 24, 1931, H. C. Severin, 1♂, 1♀. NEWELL: June 19, 1923, H. C. Severin, 1♂. SPRINGFIELD: June 15, 1928, H. C. Severin, 1♀. YANKTON: June 18, 1930, G. I. Gilbertson, 2♂, 4♀; June 25, 1934, H. C. Severin, 2♀.

TEXAS.—EL PASO: April 22, 1939, J. A. & H. H. Ross, 8♂ (brachypterous), ♀♀, 3 exuviae.

WYOMING. — Madison Junction, YELLOWSTONE NATIONAL PARK, Gibbons River: July 8, 1936, H. H. Ross, 1♀. PINEDALE, Green River north of town: July 6, 1936, H. H. Ross, 1♂. UPTON: June 20, 1940, J. A. & H. H. Ross, 2♂, 1♀.

Isoperla mormona Banks

Isoperla mormona Banks (1920, p. 322). Original description, ♀.

Isoperla insipida Hoppe (1938, p. 157). Original description, ♂, ♀. New synonymy.

This species is apparently closely related to *longiseta* Banks, as mentioned in the discussion of that species. The type, a single female, No. 10,822, from "Vineyard, Ut.," in the collection of the Museum of Comparative Zoology, has been studied and compared with specimens in the Illinois Natural History Survey collection. Also, through the kindness of Professor Trevor Kincaid of the University of Washington, I have had the opportunity of studying the holotype and allotype of *insipida*, as well as most of the paratypic specimens. I find them all to be synonymous with *mormona*, which is apparently a Rocky Mountain and West Coast species, meeting with *longiseta* in such states as Wyoming and Montana.

Records for this little-known species contained in the collection of the Illinois Natural History Survey or identified for others are as follows.

ARIZONA.—COCONINO COUNTY, Oak Creek at Indian Garden: June 13, 1937, Leonora K. Gloyd, 4♂, 3♀.

MONTANA.—TOSTON, Missouri River: June 22, 1940, H. H. & J. A. Ross, 3♂, 7♀.

OREGON.—BENTON COUNTY, Oak Creek: R. E. Rieder, 1♂, 1♀. CORVALLIS: April 18, 1939, S. E. Crumb, Jr., 1♂; April 21, 1938, W. M. W., 1♂. FRENCHGLEN, Harney County, Blitzen River: July 7, 1935, S. G. Jewett, Jr., 1♂, 6♀; July 11, 1935, 9♂, 6♀; Aug. 2, 1935, 1♀. Granger Station, near CORVALLIS: April, 1938, N. A. Ramsdell, 6♂, 2♀. KLAMATH COUNTY, Crooked Creek: July 8, 1940, F. Glover, 8♂, ♀♀. MALHEUR COUNTY, Trout Creek: July 30, 1937, S. G. Jewett, Jr., 3♂, 3♀. MOLALLA, Clackamas County, Molalla River: July 1, 1935, S. G. Jewett, Jr., 1♀. PENDLETON: June 5, 1934, R. E. Dimick, 1♀. SUTTLE LAKE, 3,435 feet elevation: Aug. 6, 1935, H. A. Scullen, 1♀.

UTAH.—AMERICAN FORK: July 6, 1939, G. F. Knowlton, 1♂, 2♀. ELSINORE: July 22, 1937, G. F. Knowlton, 4♂, 2♀. HEBER: July 25, 1940, G. F. Knowlton, 1♀. LEHI: July 2, 1939, G. F. Knowlton, 4♀. LOGAN CANYON: May 17, 1933, G. F. Knowlton, 1♀. MILFORD: July 2, 1941, Knowlton & Hardy, 1♂. ORTON: July 5, D. J. & J. N. Knull, 1♀. SUNSET: July 26, 1933, G. F. Knowlton, 3♀.

WYOMING. — BOULDER, tributary of Pine Branch River: July 6, 1936, H. H. Ross, 2♀. MADISON JUNCTION, Yellowstone National Park, Gibbons River: July 8, 1936, H. H. Ross, 1♂, 2♀.

Since *insipida* is a synonym of *mormona*, the Washington and Oregon records associated with *insipida* must now be referred to *mormona*.

Isoperla dicala new species

MALE.—General color creamy yellow with fuscous or brownish areas. General type of coloration similar to that of the *Isoperla bilineata* (Say) complex. Dorsum of head dominantly creamy yellow without a dark V-shaped area uniting lateral and median ocelli, a few small dusky or brownish spots adjacent to ocelli, fig. 98. Pronotum with margins and a wide, median, longitudinal stripe creamy yellow; area each side of stripe with raised rugosities dusky or brownish, fig. 98. Mesonotum and metanotum mostly creamy yellow but each with a dusky or brownish spot on central posterior area, fig. 98. Abdomen entirely creamy yellow. Legs, except for brownish tarsi, essentially creamy yellow. Antennae with basal segments creamy yellow and succeeding segments fuscous or brown. Anal cerci creamy yellow.

Head slightly wider through compound eyes than width of pronotum; lateral ocelli farther distant from one another than each is distant from median ocellus, distance between each lateral ocellus and inner margin of compound eye about one-half the distance between lateral ocelli.

Pronotum approximately quadrangular, broader than long, a distinct pattern of raised rugosities on surface each side of yellow, median, longitudinal stripe, fig. 98.

Legs with first and second tarsal segments together much shorter than third, first tarsal segment longer than second.

Wings mostly very pale or hyaline, with stigmal areas milky; veins mostly pale, but costal and some in middle area of wing brown.

Abdomen, fig. 98, with tenth tergite not cleft; subanal lobes weakly developed and scarcely visible from above; ninth sternite, fig. 98, produced backwards so that apical tergites are not visible in ventral view, eighth sternite with a prominent long,

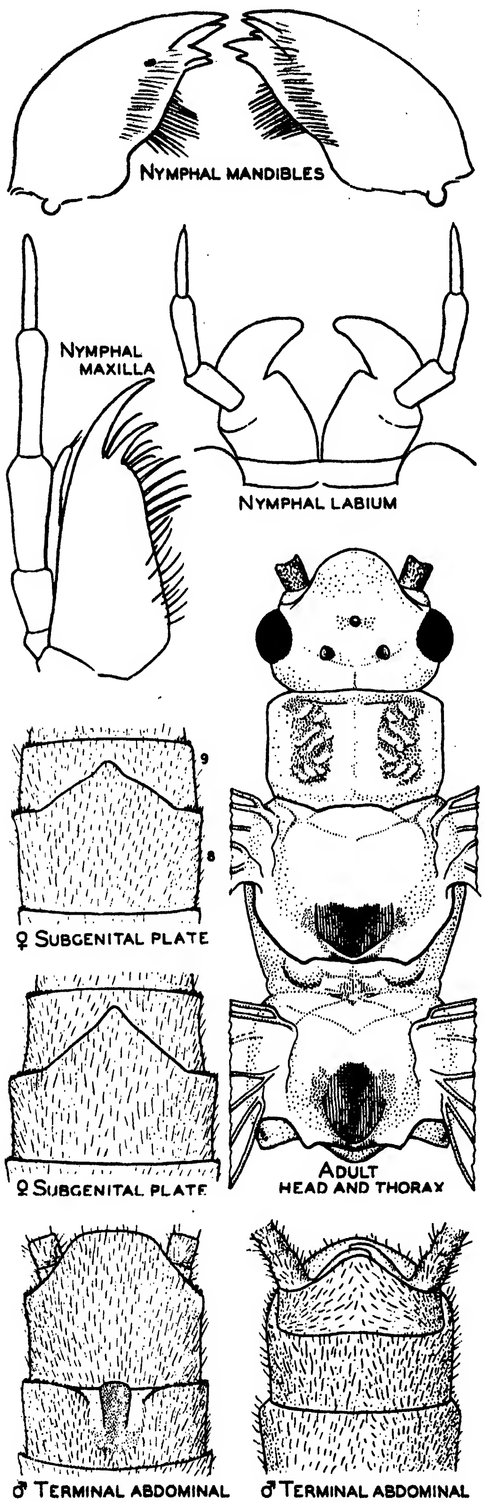


Fig. 98.—*Isoperla dicala.*

deeply recessed lobe in middle of posterior margin.

Length to tip of wings 11 mm.; length to tip of abdomen 8 mm.

FEMALE.—Head, thorax and basal abdominal segments and appendages in general similar to those of male, but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 98, triangularly produced over ninth sternite and with sides slightly curved inwards on each side just before extreme tip.

Holotype, male.—Free Soil, Great Sable River, Mich.: reared from nymph, May 26, 1939, T. H. Frison & H. H. Ross.

Allotype, female.—Same data as for holotype.

Paratypes.—MICHIGAN. — FREE SOIL: Same data as for holotype, 14♂, 8♀. Osceola County, Pine River near LUTHER: June 27, 1936, 2♀. LAKE COUNTY, Pine River: June 3, 1938, R. P. Bohlard, 5♂, 2♀.

Other specimens which I am identifying as this species but which I do not want to include as paratypes because of lack of nymphs from same general area are as follows.

TENNESSEE.—SEVIERVILLE, at light: June 11, 1938, T. H. Frison & T. H. Frison, Jr., 1♂, 13♀. GATLINBURG: Little Pigeon River, June 12, 1935, H. H. Ross, 1♀; at light, June 11, 1938, T. H. Frison & T. H. Frison, Jr., 1♀; June 14, 1940, T. H. Frison *et al.*, 2♀.

MISSOURI.—GREER SPRINGS: June 7, 1937, H. H. Ross, 2♀.

MINNESOTA.—PINE COUNTY, Snake River: May 26, 1939, P. H. Harden, 1♂.

INDIANA.—KNOX, Yellow River: May 24, 1937, H. H. Ross, 1♂.

NYMPH. — General color of dorsum brown with small pale areas, fig. 99; venter, except for conspicuous, short, brown, spinelike setae on apical abdominal segments, creamy yellow. Legs, antennae and anal cerci dominantly pale yellow, with short, stout, spinelike setae on femora very numerous and conspicuous. Ocelli in same relative position as in adult. Basal segments of mouthparts not extending out from sides of head. Numerous conspicuous, short, stout, spinelike setae on dorsum, particularly prominent on back of head, anterior part of mesonotum and metanotum and on abdominal tergites. Labium, maxillae and mandibles as in fig. 98.

Pronotum broader than long, with markings as in fig. 99.

Abdominal tergites dark with a series of pale spots which tend to set off a series of longitudinal dark and somewhat lighter colored stripes, the median and two lateral stripes darkest, fig. 99. Cerci long, with many segments, progressively longer from

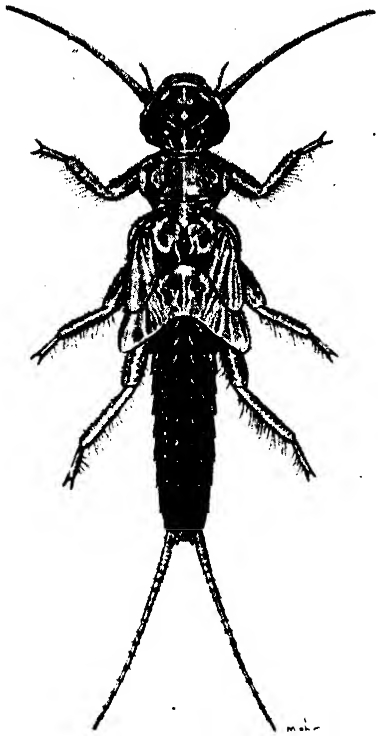


Fig. 99.—Nymph of *Isoperla dicala.*

base to apex, a longitudinal row of long, fine setae on dorsal surface of apical segments in addition to smaller spinelike ones encircling apex of each segment.

Approximately mature specimens with a body length of 10 mm.

No thoracic, anal or submental gills.

Nymphal records are as follows.

MICHIGAN.—FREE SOIL, Great Sable River: May 26, 1939, T. H. Frison & H. H. Ross, numerous nymphs. RAPID RIVER, Rapid River: May 12, 1940, T. H. Frison & H. H. Ross, 4 nymphs. BALDWIN, Pere Marquette River: May 9–10, 1940, T. H. Frison & H. H. Ross, 8 nymphs. PEACOCK, Little Manistee River: May 10, 1940, T. H. Frison & H. H. Ross, 15 nymphs. IRONS, Little Manistee River: May 28, 1939, T. H. Frison & H. H. Ross, many nymphs. HONOR, Platte River: May 27, 1939, T. H. Frison & H. H. Ross, 1 exuvia. BRUNSWICK, Brooks Creek: May 29, 1939, T. H. Frison & H. H. Ross, 1 exuvia. CRAWFORD COUNTY, near branch of Au Sable River: May 18, 1936, J. N. Leonard, 1 nymph.

MINNESOTA.—ELY, 12 miles southeast, Kawishiwi River: June 21, 1939, R. H. Daggy, 1 nymph.

NEW BRUNSWICK. — PENOBSQUIS: Aug. 20, 1939, T. H. Frison & T. H. Frison, Jr., 1 exuvia.

This species, on the basis of habitus, belongs in the *Isoperla* group or complex containing *bilineata*. The long, deeply recessed lobe in the middle of the posterior margin of the eighth abdominal sternite in the male easily separates it from *bilineata*, as does also the lack of a V-shaped line connecting ocelli on the head. The nymph is very dark, with numerous conspicuous, short, stout setae; in this respect reminding one of *minuta* (Banks), but the head pattern is quite different, and maxillae have two large teeth at apex instead of one.

Adults were observed at Free Soil, Mich., to be emerging during the daytime from nymphs clinging to logs on the sides of the river bank. This habit of emerging during the day has been noted in the case of another species, *decepta* Frison, in Illinois.

Isoperla orata new species

FEMALE.—General color creamy yellow with fuscous or brown markings. General type of coloration similar to that of the *Isoperla bilineata* (Say) complex. Dorsum of head, fig. 100, mostly creamy yellow; compound eyes and area immediately surrounding ocelli black; lateral ocelli connected with median ocellus by short, dark stripes which connect with a large, solid, transverse, graduate, dark patch adjacent to median ocellus. Pronotum mostly creamy yellow except for fuscous or brownish area associated with raised rugosities, fig. 100. Mesonotum and metanotum mostly creamy yellow with some fuscous or brownish areas. Abdomen essentially creamy yellow with slight traces of fuscous longitudinal stripe on tergites. Antennae, legs and anal cerci practically concolorous with body.

Head wider through compound eyes than pronotum; ocelli forming an almost equilateral triangle, lateral ocelli somewhat farther apart than each is distant from inner margin of compound eye.

Pronotum broader than long, approximately quadrangular in shape, a distinct pattern of raised rugosities on disk each side of median pale-colored stripe.

Legs with first and second tarsal segments together much shorter than third, first tarsal segment longer than second.

Wings very pale or hyaline with stigmal

areas milky; veins pale and almost concolorous with connecting membrane.

Abdomen, fig. 100, with no distinctive features except for shape of subgenital plate on posterior margin of eighth sternite; subgenital plate extends somewhat over ninth sternite, is broadly rounded on posterior margin, slightly indented at tip, and with a concave, transverse valley at its base; subgenital plate, as viewed from side, tends to extend away from abdomen much as in *truncata* Frison.

Length to tip of wings 11 mm.; length to tip of abdomen 7 mm.

MALE.—Head, thorax and basal abdominal segments in general similar to those of female, but slightly smaller in size. Important differences or structures are as follows: tenth tergite not cleft, fig. 100, subanal lobes weakly developed and but slightly visible from above; ninth sternite, fig. 100, produced backwards so that apical tergites are not visible in ventral view; eighth sternite with a shallowly recessed but distinct lobe in middle of posterior margin.

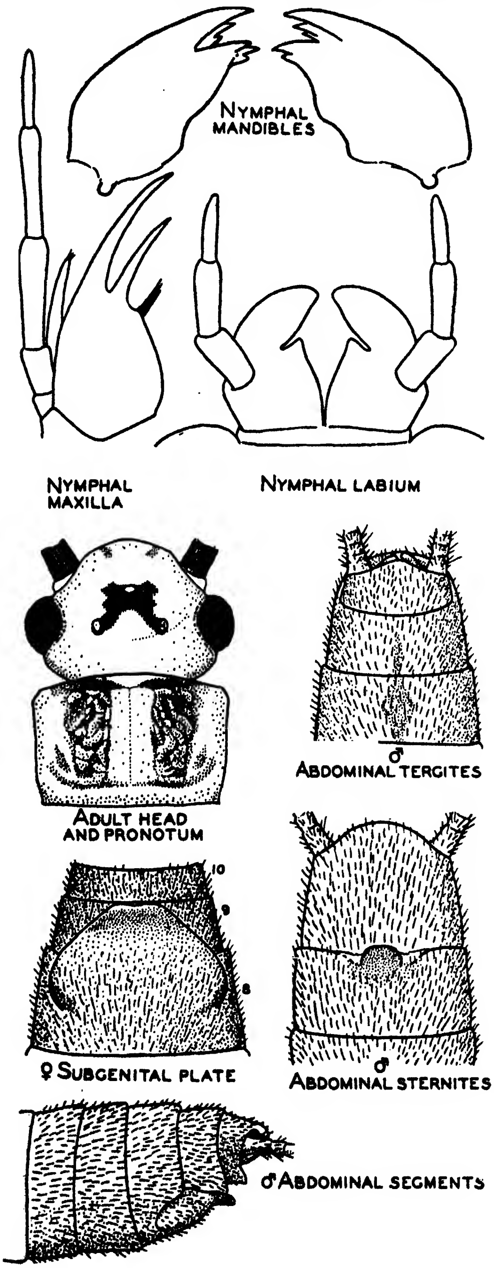


Fig. 100.—*Isoperla orata.*

Holotype, female. — Gatlinburg, Le Conte Creek, Tenn.: reared from nymph, May 14, 1939, T. H. Frison & H. H. Ross.

Allotype, male.—Same data as for holotype.

Paratypes.—TENNESSEE.—GATLINBURG: Same data as for holotype, 5♀; same data as for holotype except not reared, 5♂, 18♀; June 14, 1940, T. H. Frison *et al.*, 1♀, reared from nymph; same data except not reared, 16♀; fork of Little Pigeon River, May 27, 1934, T. H. Frison, 1♂, 4♀; Fighting Creek Gap, May 15, 1939, T. H. Frison & H. H. Ross, 1♂, 2♀. ELKMONT, June 13, 1940, T. H. Frison *et al.*, 1♀.

NEW YORK.—Keene, tributary of Sable River: June 20, 1941, T. H. Frison & H. H. Ross, 3♂, 4♀. EUBA MILLS, Adirondack Park: June 20, 1941, T. H. Frison & H. H. Ross, 1♂, 1♀. HAWKINSVILLE, Black River: June 19, 1941, T. H. Frison & H. H. Ross.

NEW HAMPSHIRE. — BENTON, Witcherville Brook: June 21, 1941, T. H. Frison & H. H. Ross, 12♂, 3♀.

NORTH CAROLINA.—SMOKEMONT, Oconaluftee River: May 28, 1934, T. H. Frison.

PENNSYLVANIA.—SWIFTWATER, Monroe County: 1928, F. R. Nevin, 2♀ (A.N.S.).

VERMONT. — TOPSHAM, Waits River: June 21, 1941, T. H. Frison & H. H. Ross, 3♂.

NYMPH.—General color yellow with dark markings on dorsum of head, thorax and abdomen, fig. 101. Legs, antennae and anal cerci dominantly pale yellow. Short, stout, spinelike setae, in addition to longer hairs, present on body and legs but bases not conspicuous as in such species as *decepta* Frison and *dicala* Frison, the latter described in this paper. Ocelli in same relative position as in adult. Basal segments of mouthparts not extending out from sides of head. Labium, maxillae and mandibles as in fig. 100.

Pronotum broader than long with dark markings on disk, as in fig. 101.

Longitudinal dark stripes on abdominal

tergites tend to be connected on hind margin of segments by narrow transverse line which gives tergites somewhat the appearance of having cell-like light spots each side of median, longitudinal stripe.

Cerci long, many segments, progressively longer from base to apex, a longitudinal row of long, fine setae on dorsal surface of apical segments in addition to smaller, stout, spinelike ones encircling apex of each segment.

Approximately mature specimens with a body length of 8 mm.

No thoracic, anal or submental gills.

Nymphal records are as follows.

TENNESSEE.—GATLINBURG, Le Conte Creek: May 14, 1939, T. H. Frison & H. H. Ross, 2 nymphs, numerous exuviae. West of OZONE: May 15, 1939, T. H. Frison & H. H. Ross, 4 exuviae. ELKMONT, Little River: May 14, 1939, T. H. Frison & H. H. Ross, 9 exuviae.

NORTH CAROLINA.—SMOKEMONT, Oconaluftee River: May 28, 1934, 10 nymphs.

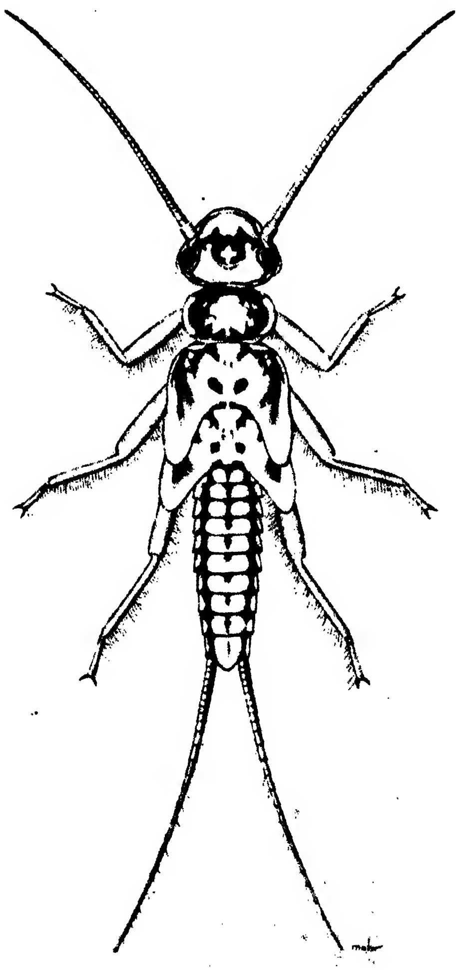


Fig. 101.—Nymph of *Isoperla orata.*

This is another species belonging to the group or complex of *Isoperla* species containing *bilineata* (Say). The shape of the dark area connecting the lateral and median ocelli is very suggestive of *truncata* Frison, but the color pattern of the nymph and the much broader subgenital plate of the adult female indicate it is a distinct species. That the two species may occur in the same territory, at least in northern states, is shown by the collection of adult females of both *truncata* and this new species at Hawkinsville, Black River, N. Y., June 19, 1941 (T. H. Frison & H. H. Ross). Apparently *truncata* is most abundant in the north central states region and this new species in mountainous areas of the eastern states.

Isoperla similis (Hagen)

Perla similis Hagen (1861, p. 26). Original description, ♀.

This species was originally described from the female and recorded from "Pennsylvania and Maryland." A single female typic specimen from "Pennsylvania—Uhler—1858" is in the collection of the Museum of Comparative Zoology (Type No. 250) and has been compared with reared material in the Illinois Natural History Survey collection. Needham & Claassen (1925) gave additional distributional records from New Hampshire and New York and described the previously unknown male, but did not figure any of the important structural features of the adults.

Claassen (1931) gave a brief verbal description of the nymph based upon a male nymphal skin from which the adult was reared. Evidently this nymphal skin did not show the distinctive color pattern of the nymph, which is somewhat suggestive of *Diploperla hastata* (Banks); at least it was not noted. The pale, longitudinal stripe down the middle of the otherwise brownish abdominal tergites, coupled with the color pattern of the head, helps to recognize this species, fig. 102. The maxillae, mandibles and labium of the nymph are as in fig. 103.

To aid with the future identification

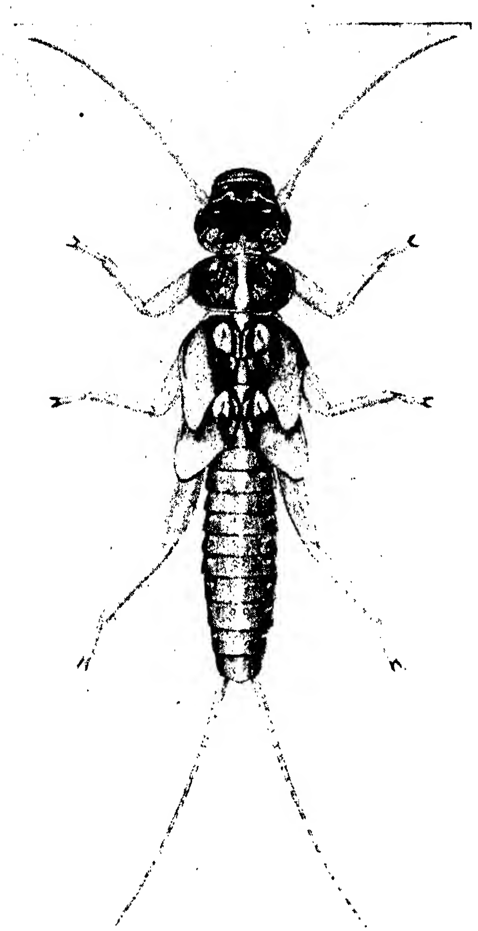


Fig. 102.—Nymph of *Isoperla similis.*

of the adults of this species, I present illustrations of the terminal abdominal sternites of the male showing lobe on posterior margin of eighth sternite, fig. 103, the terminal abdominal sternites of the female showing shape of subgenital plate (eighth sternite), fig. 103, and the color pattern of the dorsum of the head and pronotum, fig. 103.

Additional distributional records based upon Illinois Natural History Survey collections and material submitted for identification are as follows.

Connecticut. — Waterbury, Bristol Park: March 24, 1937, H. H. Ross, 8 nymphs.

New Hampshire. — Nelson, Silver Lake Stream: Aug., 1930, C. N. Hardy, 2 nymphs.

New York.—Ringwood: April 30, 1937, Lot 770, 1 nymph.

North Carolina. — Blowing Rock, near Grandfather Mountain, west of town: March 23, 1940, Frison, Mohr & Hawkins, 7 nymphs. Newfound Gap: 3,560 feet altitude, May 28, 1934, T. H. Frison, 1♂, 1 nymph; Little Pigeon River, June 13, 1935, H. H. Ross, 1♂.

Pennsylvania.—Swiftwater, Monroe County: 1928, F. R. Nevin, Lot 258, 1♀.

Tennessee.—Gatlinburg: Le Conte Creek, May 14, 1939, Frison & Ross, 9 exuviae; March 24, 1940, Frison, Mohr & Hawkins, 1 nymph; June 13, 1940, T. H. Frison *et al.*, 4♂, 3♀; Le Conte Creek, June 14, 1940, T. H. Frison *et al.*, exuviae. Newfound Gap, Little Pigeon River: May 14, 1939, Frison & Ross, 1♀ (reared), ♂♂, 6♀, 4 nymphs,

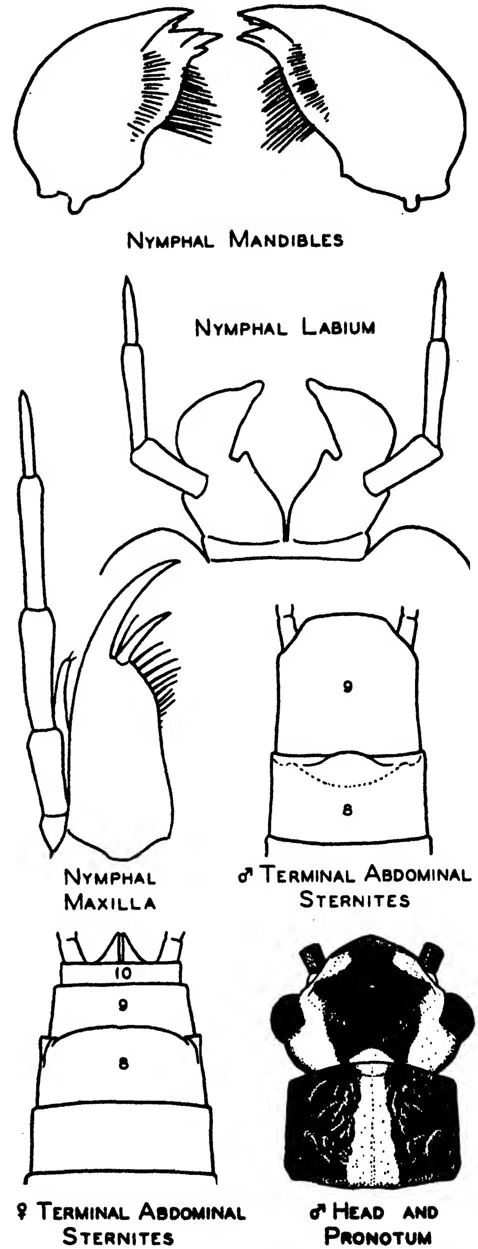


Fig. 103.—*Isoperla similis.*

exuviae. Great Smoky Mountains National Park, Greenbrier Cove: March 18, 1939, A. C. Cole, 1♂.

Virginia.—Elkton, Elk River: Jan. 1, 1939, Frison & Burks, 1 nymph. Falls Church: 4–22 (collection of N. Banks), 1♀. Great Falls: Potomac River, March 26, 1938, B. D. Burks, 1♂; Potomac River, April 3, 1938, B. D. Burks, 1♀, 2 exuviae; April 10, 1938, B. D. Burks, 2 exuviae. Lydia: April 20, 1938, Ross & Burks, 2♂, 1 exuvia. Shenandoah National Park, Big Meadows: April 20, 1938, Ross & Burks, nymphs; April 30, 1940, T. H. Frison *et al.*, ♂ with exuvia (reared). Skyline Drive, south of Front Royal: March 17, 1940, T. H. Fsison *et al.*, 2 nymphs. Standardsville: March 21, 1940, Frison, Mohr & Hawkins, 2 nymphs.

Isoperla namata new species

Male.—General color in life bright yellow with dusky or fuscous areas. Dorsum of head yellow with dark or dusky markings as follows: a V-shaped mark connecting median and lateral ocelli, portion of head anterior to median ocellus and several patches on posterior margin of head behind eyes, fig. 104. Pronotum with a broad, median, longitudinal, yellow stripe somewhat constricted in the middle, and with fuscous raised rugosities each side of stripe, fig. 104. Mesonotum and metanotum with medial and posterior portions yellow and remainder of dorsum and most of sides dark brown or fuscous. Abdomen on dorsum with a narrow, dark, median, longitudinal stripe and a broader, dark, longitudinal stripe on each lateral margin extending to about the ninth tergite, the ninth and tenth tergites mostly yellow. Legs with trochanters, coxae and tips of femora yellow, tibiae and most of femora dark or fuscous. Antennae and anal cerci with all segments black. In specimens which have been preserved in fluid, the bright yellow color tends to become cream colored and the fuscous or dark areas tend to become dark brown.

Head slightly wider through compound eyes than width of pronotum; lateral ocelli farther distant from one another than each is distant from median ocellus; distance between compound eye and lateral ocellus about the same as between lateral ocellus and median ocellus.

Pronotum approximately quadrangular, broader than long, a distinct pattern of raised rugosities on surface each side of yellow, median, longitudinal stripe, fig. 104.

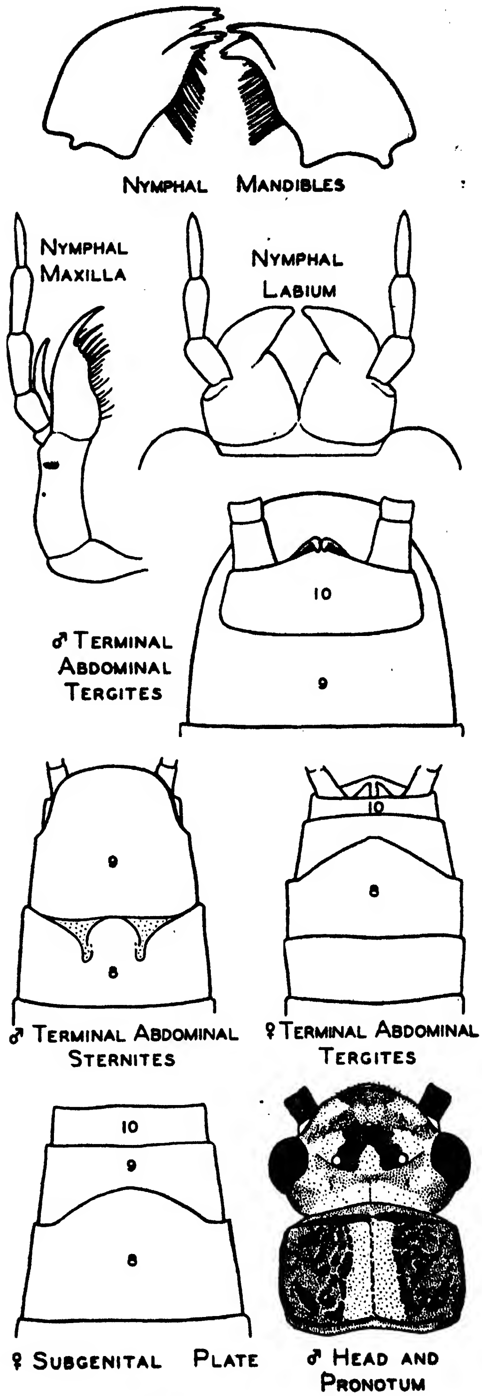


Fig. 104.—*Isoperla namata.*

Abdomen, fig. 104, with tenth tergite not cleft; subanal lobes weakly developed into short finger-like processes; ninth sternite, fig. 104, produced backwards so that

apical tergites are not visible in ventral view, eighth sternite with a prominent rounded lobe in middle of posterior margin.

Legs with first and second tarsal segments together shorter than third; first tarsal segment slightly longer than second.

Wings slightly suffused with brown; veins uniformly dark brown.

Length to tip of wings 11 mm.; length to tip of abdomen 8 mm.

FEMALE.—Head, thorax and basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 104, with subgenital plate slightly produced over ninth sternite and rounded.

Holotype, male. — Silva, Wayne County, Mo.: reared April 8, 1938, from nymph collected April 7, 1938, T. H. Frison & Carl O. Mohr.

Allotype, female.—Same data as for holotype.

Paratypes.—MISSOURI.—SILVA: Same data as for holotype, 11♂, 14♀. Same data as for holotype except date (all 1938): April 7, 1♀; April 12, 2♀; April 16, 1♂, 4♀. ZION, Madison County: reared April 15, 1♂, 2♀; April 18, 1♂, 2♀; April 20, 1♂; April 21, 1♂, 1♀; April 22, 1♀; April 24, 1♀; all collected as nymphs, April 7, 1938, by T. H. Frison & Carl O. Mohr, and reared.

INDIANA.—MCCORMICK'S CREEK STATE PARK: April 16, 1938, 2♂, 1♀; April 23, 1938, 1♂; all reared from nymphs collected April 16 by T. H. Frison.

NYMPH. — General color pale yellow with fuscous areas on head, thorax and abdomen, as in fig. 105. Legs, antennae and anal cerci pale yellow. Head with ocelli forming an almost equilateral triangle; basal segments of mouthparts not conspicuously extending out from sides of head. Labium, mandibles and maxillae as in fig. 104.

Pronotum broader than long with markings as in fig. 105.

Abdominal tergites having general background creamy yellow with fine, longitudinal, dark stripes, one in middle and one on each side, a series of prominent, small, dark spots associated with dark stripes, fig. 105; some scattered, stout, short, pale setae on tergites in addition to row on posterior margin of each segment. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on dorsal surface of apical segments in addition to smaller spinelike ones encircling apex of each segment.

Approximately mature specimens with body length of 9 mm.

No thoracic, anal or submental gills.

Nymphal records are as follows.

INDIANA.—MCCORMICK'S CREEK STATE PARK: April 16, 1938, T. H. Frison, 6 nymphs.

MISSOURI.—SILVA, Wayne County: April, 7, 1938, T. H. Frison & C. O. Mohr, 17 nymphs; March 27, 1937, T. H. Frison, 3 nymphs.

The general shape of the subgenital plate of the female, the lobe on eighth sternite of male and subanal lobes of male, as well as general pattern of fuscous markings on dorsum of adult, approach very closely those of *signata* (Banks). That the species here described as new is not *signata* is definitely proved by the marked differences in color patterns of the nymphs; in fact, it was the distinctiveness of the nymphal color pattern observed in

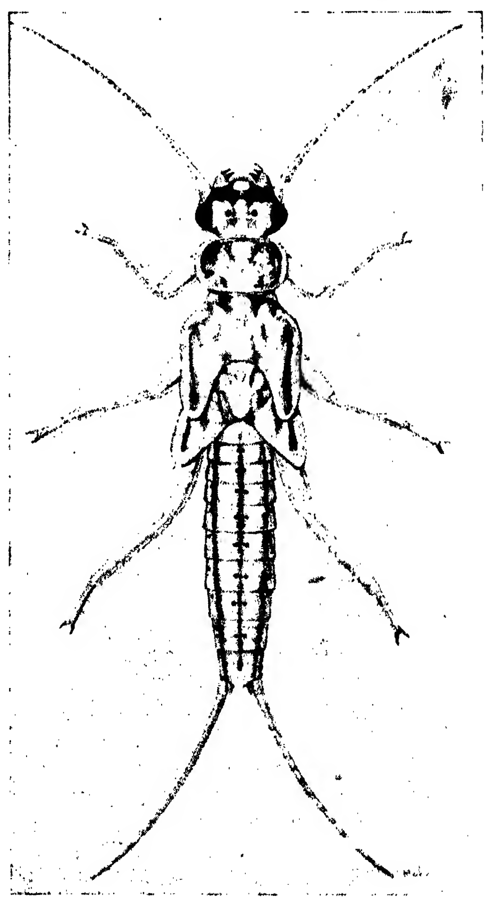


Fig. 105.—Nymph of *Isoperla namata.*

1937 which led to additional collections of nymphs in 1938 and the rearing of the adults. The adults of *signata* are much larger than those of this new species and the body integument is heavily suffused with brown, whereas in this new species the body integument is very pale colored. The apical segments of the anal cerci in the adults of *signata* are much longer than comparable segments of this new species.

Isoperla slossonae (Banks)

Perla slossonae Banks (1911, p. 335). Original description, ♂, ♀.
Clioperla annecta Needham & Claassen (1925, p. 140). Original description, ♀. New synonymy.

Studies of the single female type of *slossonae* in the collection of the Museum

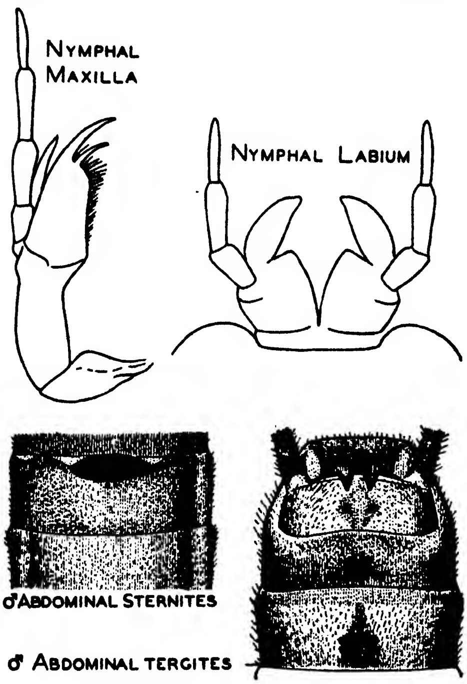


Fig. 106.—*Isoperla slossonae.*

of Comparative Zoology (Type No. 11,-327), and the typic female series of *annecta*, in the collection of Cornell University, have revealed that these specimens are of the same species and hence the more recent name of *annecta* falls in synonymy. For the sake of exactness in record, it may be stated that the type of *slossonae* is somewhat darker in coloration than the typic series of *annecta* and most specimens in the Illinois Natural History Survey collection, but such a difference in degree of coloring often occurs in stonefly species.

The original description of *slossonae* mentions both the male and female, but only a single female type is now in the collection at Cambridge. The original description of *annecta* is based upon females only, collected in New York and Quebec.

Since neither Banks (1911) or Needham & Claassen (1925) have figured the male or described certain important characters useful in identifying it, I present the following brief description of certain structures.

MALE.—Agrees in general with description of *annecta* as given for female by Needham & Claassen (1925). Important structural differences are as follows: Subanal lobes developed into prominent sturdy hooks; ninth abdominal sternite much produced, fig. 106; eighth abdominal sternite with a broad, shallow lobe on posterior margin, fig. 106. Very suggestive of and closely related to *pinta* Frison (1937).

As a result of field work in several states, which enabled me to rear males and females from nymphs, I am now able to present the following description of the nymph.

NYMPH.—General color pale yellowish, with darker areas on dorsum of head, thorax and abdomen, as in fig. 107. Antennae, legs and anal cerci mostly yellowish, with dark bands at apex of femur and base of tibia especially prominent.

Head with three ocelli forming an almost equilateral triangle, each lateral ocellus about as far apart as each is distant from inner edge of compound eye; no occipital ridge; basal segments of mouthparts but slightly extending out from sides of head. Labium and maxillae as in fig. 106.

Pronotum much broader than long, with markings as in fig. 107, corners very much rounded.

Abdominal tergites with a general dark brown to black background, with rows of light spots, fig. 107, posterior margin of tenth or last tergite yellowish. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on apical segments in addition to smaller, spinelike ones encircling apex of each segment.

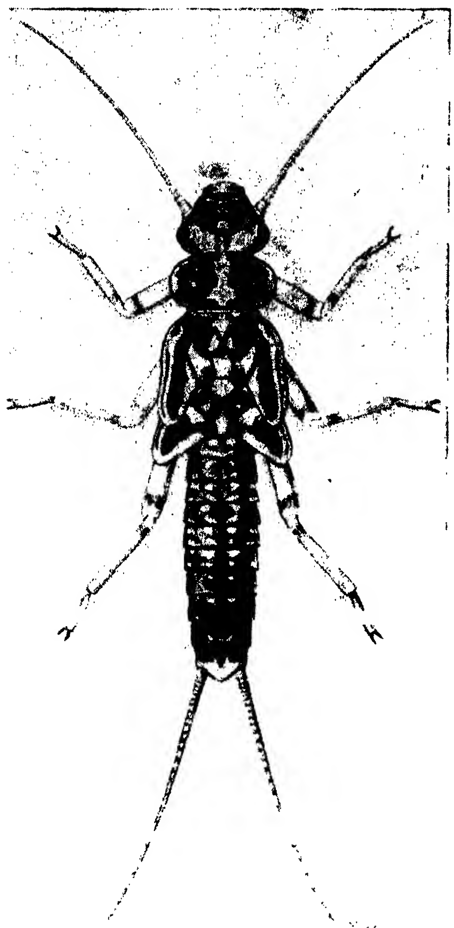


Fig. 107.—Nymph of *Isoperla slossonae.*

Mature specimens with body length, exclusive of appendages, up to 14 mm.
No gills present.

New records for this species based upon specimens submitted for identification and Illinois Natural History Survey collecting are as follows.

MAINE.—DOUBLE TOP MOUNTAIN, Sourdnahunk River: Aug. 27, 1939, T. H. Frison & T. H. Frison, Jr., 2 exuviae.

MICHIGAN.—BALDWIN, Pere Marquette River: May 28, 1939, Frison & Ross, 2♀, 2 exuivae; May 9–10, 1940, Frison & Ross, 3♂, 9♀, 1 nymph, exuviae, 2♀ with exuviae (reared). CRAWFORD COUNTY, Au Sable River: Feb. 23, 1936, J. W. Leonard, 1 nymph. Near LOVELLS: March 23, 1936, J. W. Leonard, 10 nymphs. FIFE LAKE, near Canada Creek: Oct., 1935, 5 nymphs. GRAND TRAVERSE COUNTY, Boardman River, 3 miles above Traverse City Power Company dam, T. 26N., R. 9W., Sec. 18: May 7, 1935, J. W. Leonard, 8♂, 6♀. GRAYLING, Manistee River: May 22, 1936, Frison & Ross, 5♀. HONOR, Platte River: May 27, 1939, Frison & Ross, 4 exuviae; May 10, 1940, Frison & Ross, ♂♂, 6♀, 2 nymphs, 6 exuviae. KLACKING CREEK, northwest branch: Oct. 14, 1935, 5 nymphs. LAKE COUNTY: middle branch of Pere Marquette River, south of Nirvana, Nov. 5, 1936, J. W. Leonard, 4 nymphs; Pine River, Walker Bridge Camp, May 29, 1938, J. W. Leonard, 1♀; Pine River, Walker Bridge Camp, May 30, 1938, O. H. Clark, 1♂. LEWISTON, Hunt Creek: Oct. 28, 1935, 7 nymphs. LOVELLS, Au Sable River: May 22, 1936, Frison & Ross, 4♂, 2♀, 2 exuviae. Near LOVELLS, north branch of Au Sable River: May 24, 1936, J. W. Leonard, 2♀. OSCODA COUNTY, Perry Creek: Oct. 29, 1936, J. W. Leonard, 2 nymphs. PEACOCK, Little Manistee River: Oct., 1935, 4 nymphs; Oct. 24, 1935, 2 nymphs; May 10, 1940, Frison & Ross, 2♀, 2 nymphs, exuviae. ROSE CITY, Houghton Creek: Oct. 15, 1936, 6 nymphs. WOLVERINE, Maple River: Sept. and Oct., 1935, 2 nymphs.

MINNESOTA. — BLOOMINGTON, Nine Mile Creek: March 31, 1935, L. L. Smith, 10 nymphs; April 5, 1935, L. L. Smith, 1♀, 1 exuvia; April 9, 1935, L. L. Smith, 2♀ (reared); April 10, 1935, L. L. Smith, 1♂ and 1♀ (reared); April 13, 1935, L. L. Smith, 2♀ (reared); April 14, 1935, L. L. Smith, 1♂, 3 nymphs. COON CREEK: April 20, 1935, H. B. Welshonse, 1 nymph. HENNEPIN COUNTY: Nine Mile Creek, May 5, 1933, C. E. Mickel, 1♀; May 2, 1936, C. E. Mickel, 2♀; May 1, 1937, R. du Toit, 1♂, 1♀; May 1, 1937, H. S. Telford, 1♀; May 3, 1937, M. T. Jen, 1♀.

NEW HAMPSHIRE. — Glen House, MOUNT WASHINGTON: June 22, 1941, T. H. Frison & H. H. Ross, 1 ♀ (compared with type of *slossonae* in M.C.Z.).

NOVA SCOTIA.—SPRINGHILL JUNCTION: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 1 exuvia.

WISCONSIN.—BOULDER JUNCTION: April 9, 1937, Frison & Mohr, 1♀ nymph; April 29, 1937, Frison & Mohr, 1♂ (reared); May 10, 1937, Frison & Mohr, 1♀ (reared).

Isoperla marlynia Needham & Claassen

Isoperla marlynia Needham & Claassen (1925, p. 148). Original description, ♂, ♀.

Chloroperla montana Banks (1898, p. 199). In part, ♂ paratypic specimen.

Isoperla clio Needham & Claassen (1925, p. 139). In part, misidentification.

Isoperla clio Claassen (1931, p. 69). Erroneous nymphal association.

Isoperla clio Frison (1935*a*, p. 439). Nymph.

Numerous rearings of North American species of *Isoperla* have revealed considerable confusion in identification of species under the specific names of *clio* (Newman), *marlynia* Needham & Claassen and *confusa* Frison. In the first place, there is very great uncertainty in regard to which North American species the name *clio* applies. Until this uncertainty is

definitely eliminated by a restudy of the typic specimens, and they are carefully compared with all North American species of *Isoperla* likely to be the true *clio*, the use of this specific name means continual confusion. I plan to follow the course, therefore, of not using the name *clio* for the time being. Ricker's recent comments regarding the typic specimens of *clio* do not clear up the points at issue; the specimens he accepts as types in the British Museum are stated to be from "Canada," whereas, the original description is based upon material which "inhabits Georgia." Newman's *clio* may prove to be *marlynia*, *confusa* or some other species.

Through the kindness of Dr. Henry Dietrich of Cornell University, I have had the privilege of studying all material determined by Needham & Claassen, or Claassen, as *clio* and also the typic series of *marlynia*. I find that some of the adults recorded as *clio* belong to the species which I have reared and described as *confusa* (1935*a*), and some are identical with *marlynia*, as follows: 2 male and 1 female adults from "Raleigh, N. C., March 22, 1907," are *confusa*, and 1 female adult from "Elkhart, Ind., June 18, 1902," and the nymph from "Elkhart, Ind., April," figured by Claassen (1931) are *marlynia*.

In the Museum of Comparative Zoology there are two specimens belonging to the typic series, No. 11,339, of *Chloroperla* (= *Isoperla*) *montana* Banks. One of these specimens, from "Mt. Wash'n," I relaxed and placed in alcohol when I studied it in 1939; Dr. Nathan Banks has recently informed me that it has been marked "type." The second specimen, from "Franconia, N. H.," is a pinned specimen of another species and has been marked as "paratype." This paratypic specimen, which I studied in 1941, proves to be of the same species as *marlynia* but *montana* does not fall in synonymy because the "type" specimen is another species of *Isoperla* for which the name *montana* is available. The original description of *montana* does not refer to a "type" and a "paratype," but the specimens are now so marked by Dr. Banks. It is fortunate from a nomenclatorial standpoint that the "type" specimen is the "Mt. Wash'n" specimen now in alcohol. Specimens of *Isoperla montana* considered by Needham & Claassen (1925) are, at least in part, of the same species as the specimen now in alcohol and labeled as "type." *I. montana* has a much lighter colored head pattern than *marlynia*.

The rearing of numerous specimens of adults of *marlynia* from nymphs collected in Indiana and Michigan has revealed that the nymph described by Claassen (1931) as *clio* is in reality *marlynia*. As

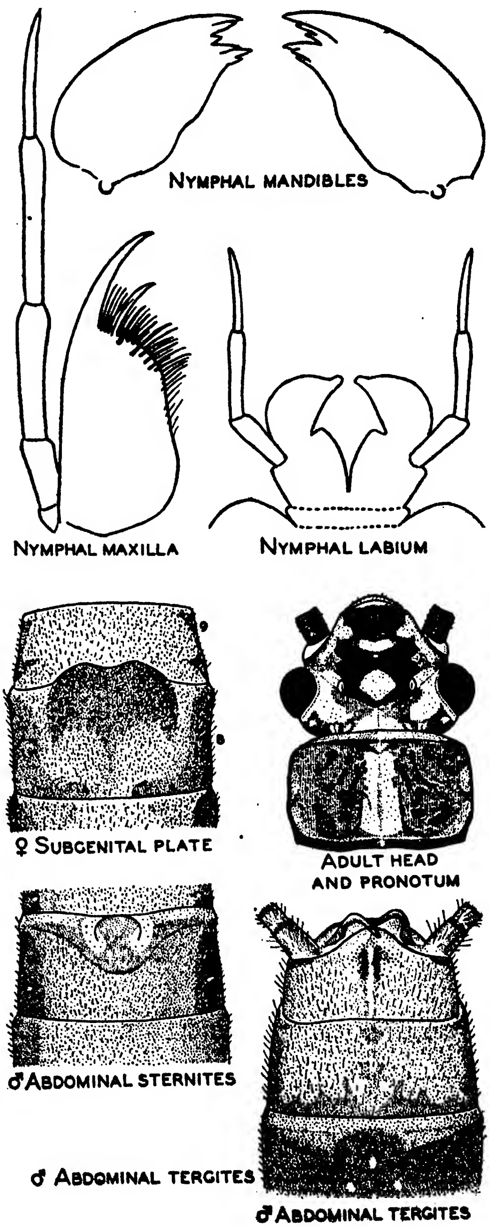


Fig. 108.—*Isoperla marlynia.*

already stated, I feel that until the true identity of *clio* is definitely established the name *clio* should not be used. My

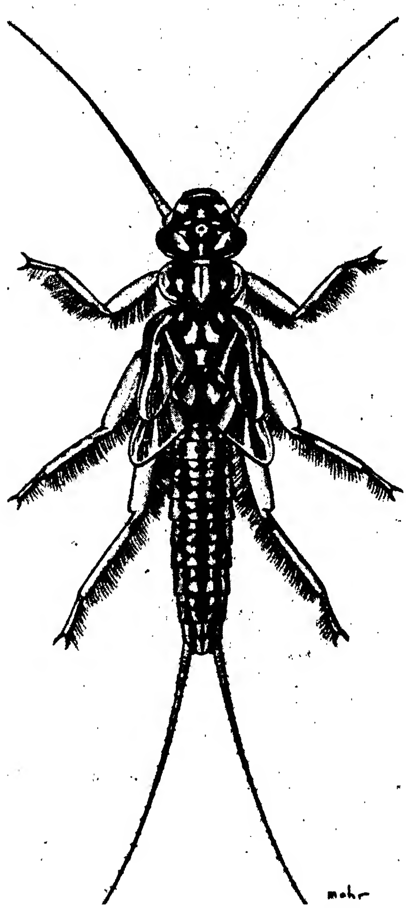


Fig. 109.—Nymph of *Isoperla bilineata*, dark phase.

1935*a* listing of certain nymphs from Illinois as *clio* followed Claassen, and therefore these records should now be associated with the name *marlynia.*

As an aid to the recognition of *marlynia*, I am presenting new illustrations, fig. 108, of the adults secured by the rearing of nymphs, and also illustrations of the mouthparts of nymphs, fig. 108, and total dorsal views of three nymphs, frontispiece.

The three nymphs exhibit variations in color patterns displayed by nymphs collected at the same time and place and which, based upon reared adult material, are unquestionably of the same species. These nymphs should serve as a warning in placing too great reliance on color patterns alone when making specific determinations of *Isoperla* nymphs. The general color patterns in this genus are a good guide to species, but consideration must be given to variation in the extension or diminishment of markings. The light nymphal form of *bilineata* (Say) was figured in my 1935*a* paper, and this seems an opportune time to present an illustration of a dark phase of the same species, fig. 109.

Isoperla marlynia has not been recorded since its original description. In addition to the records previously listed under *clio* which should be associated with this name, and which are specifically mentioned in a preceding paragraph, I can now add the following records.

ILLINOIS.—ROCKFORD, Rock River: April 3, 1928, Frison & Ross, 1♂ nymph. ROCK ISLAND, Rock River: April 2, 1928, Frison & Ross, 1♀ nymph; April 27, 1932, Frison & Mohr, 1 exuvia. (Listed by Frison 1935*a* as *clio*.)

INDIANA.—ROGERS, White River: March 14, 1936, Frison & Ross, 7 nymphs; April 16, 1936, Ross & Mohr, 1 exuvia; April 19, 1936, Ross & Mohr, 1♀ with exuvia (reared); April 24, 1936, Frison & Mohr, 1♀; April, 1940, Mohr & Burks, 1 exuvia; April 10, 1940, Mohr & Burks, 1 nymph, 2♀ with exuviae (reared); April 20, 1940, Mohr & Burks, 1♂ with exuvia (reared); April 21, 1940, Mohr & Burks, 1♂ (reared).

MANITOBA.—CHURCHILL: July 23, 1936, H. E. McClure (19CH73), 1♂.

MICHIGAN. — NAHMA JUNCTION, Sturgeon River: May 12, 1940, Frison & Ross, 9 nymphs; same except May 14, 2♂ and 2♀ with exuviae (reared); same except May 15, 7♂ and 9♀ with exuviae (reared); same except May 16, 1♂ and 1♀ with exuviae (reared); same except May 17, 4♀ with exuviae, 1♂ (reared); same except May 20, 2♂ and 4♀ with exuviae (reared). Ontonagon County, between SILVER CITY and ONTONAGON, shore of Lake Superior: May 15, 1935, J. W. Leonard, 1♀. RAPID RIVER: May 12, 1940, Frison & Ross, 1 nymph.

VIRGINIA.—REMINGTON, Rappahannock River: March 21, 1940, Frison, Mohr & Hawkins, 3 nymphs; same except April 2, 2♀ with exuviae (reared); same except April 3, 1♀ (reared).

WISCONSIN.—EDGERTON: June 5, 1936, Frison & Ross, 1♀.

Isoperla burksi new species

MALE. — General body color yellow with brown to fuscous markings. Dorsum of head with dark brown V-shaped area connecting ocelli and then extending forward to tip of head, fig. 110. Pro-

notum with a broad, median, longitudinal, yellow stripe, fig. 110; areas each side of stripe with brown to fuscous raised rugosities. Mesonotum and metanotum brown with median dorsal area palest. Abdomen creamy yellow with sides brown to fuscous. Legs, antennae and anal cerci brown to fuscous.

Head wider through compound eyes than pronotum; ocelli forming an almost equilateral triangle, lateral ocelli much farther distant from one another than each is from inner margin of compound eye.

Pronotum broader than long, approximately quadrangular in shape, a distinct pattern of raised rugosities each side of median stripe, fig. 110.

Legs with first and second tarsal segments together shorter than third; first tarsal segment longer than second.

Wings faintly tinged with brown; veins uniformly dark brown in forewings but some veins in anal area of hindwing very pale.

Abdomen, fig. 110, with tenth tergite not cleft; subanal lobes weakly developed and not recurved over tenth tergite; ninth sternite produced backwards; eighth sternite with a prominent, rather broad lobe on middle of posterior margin, fig. 110.

Length to tip of wings 11 mm.; length to tip of abdomen 9 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 110, with subgenital plate well produced backwards over ninth sternite and with tip slightly indented; as viewed from the side the subgenital plate tends to extend downwards away from abdomen.

Holotype, male. — Eddyville, Lusk Creek, Pope County, Ill.: May 1, 1940, reared from nymph, B. D. Burks & C. O. Mohr.

Allotype, female.—Same data as for holotype.

Paratypes. — ILLINOIS. — EDDYVILLE: Same data as for holotype, 1♂. Same data as for holotype except dates of rearing as follows: May 5, 1940, 1♂; May 7, 1940, 2♂, 1♀; May 13, 1940, 1♀; May 15, 1940, 1♀; May 14, 1940, 1♂, 3♀.

NYMPH.—General color pale creamy yellow with some pale brownish markings as in fig. 111. Legs, antennae and anal cerci pale yellow.

Head with ocelli forming an almost equilateral triangle, basal segments of mouthparts somewhat extending out beyond sides of head. Labium, mandibles and maxillae as in fig. 110; second hooklike tooth at tip of each maxilla very strongly developed and extending at least two-thirds as far as primary or first tooth.

Pronotum broader than long, with markings as in fig. 111.

Abdominal tergites mostly pale creamy yellow with a narrow, fuscous, transverse band on posterior margin of each tergite

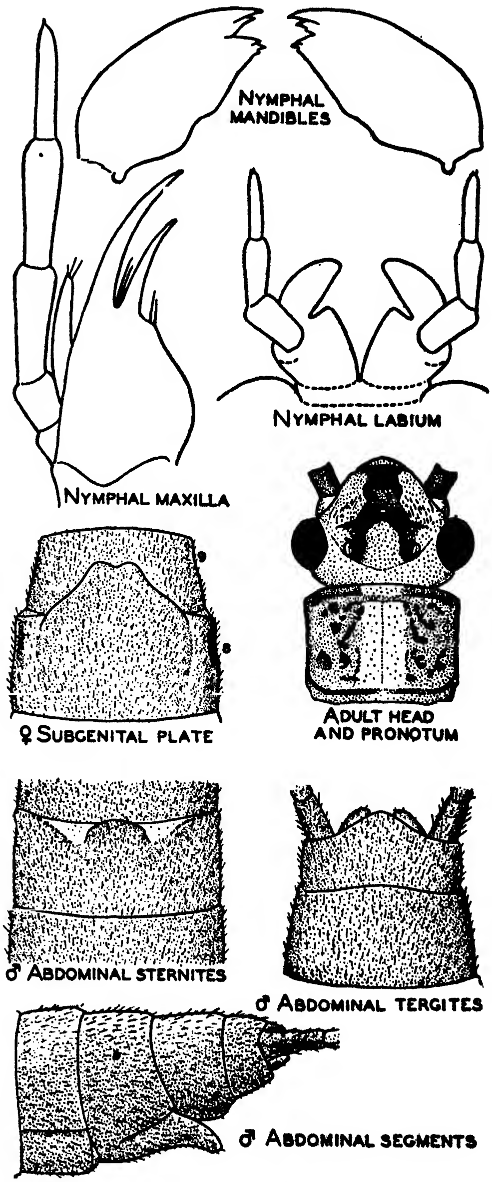


Fig. 110.—*Isoperla burksi.*

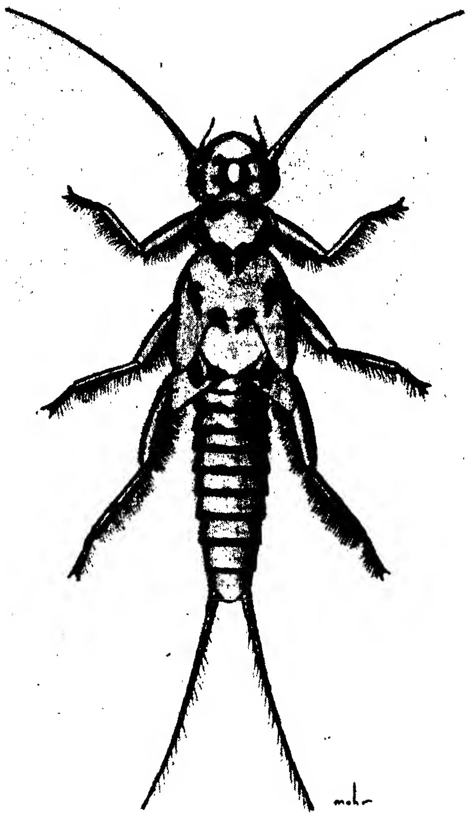


Fig. 111.—Nymph of *Isoperla burksi.*

except tenth; posterior margin of each tergite with numerous short, stout, pale setae; some scattered short, stout setae together with fine hairs on central area of tergites. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long fine setae on dorsal surface of apical segments in addition to smaller spinelike ones encircling apex of each segment.

Approximately mature specimens with body length of 11 mm.

No thoracic, anal or submental gills.

Nymphal and exuvial records are as follows.

ILLINOIS.—HEROD, Gibbons Creek: April 19, 1937, H. H. Ross & C. O. Mohr, 1 nymph. GOLCONDA: May 13, 1939, B. D. Burks & G. T. Riegel, 1 exuvia. EDDYVILLE, Lusk Creek, Pope County: April 30, 1940, 2 nymphs; May 1, 1940, 1 nymph; May 9, 1940, 2 nymphs; May 24 and June 1, 1940, many exuviae; all collected by B. D. Burks & C. O. Mohr.

This is another new species first found as a nymph and, because of distinctive features of nymph, recognized as new to the Illinois faunal list before adult was reared. Rearings and collection of material prove it to be a previously undescribed species. The combination of nymphal and adult characters separates it from all other species of *Isoperla.* Although much smaller than *ventralis* (Banks), it somewhat resembles this species in general color pattern of adult. In the nymph, the transverse bands on abdominal tergites place it with such species as *marlynia* Needham & Claassen (= *clio* of American authors).

I take pleasure in naming this species for Dr. B. D. Burks, Assistant Entomologist on the staff of the Illinois Natural History Survey, who has assisted with the collection and rearing of stonefly material in Illinois and elsewhere.

Isoperla lata new species

MALE.—Basic color brownish to black. Dorsum of head with a small yellowish spot anterior to median ocellus, another yellowish spot in ocellar triangle, and with a large yellowish area on posterior part of head running forward on each side between compound eyes and lateral ocelli, fig. 112. Pronotum with a broad, median, longitudinal, yellowish stripe, much narrower at anterior end than posterior end, fig. 112; areas each side of stripe brown to black. Mesonotum and metanotum essentially brown to black. Abdomen brown to black, with two short, pale, longitudinal stripes on the two basal tergites. Legs, antennae and anal cerci brownish.

Head slightly wider through compound eyes than width of pronotum; lateral ocelli farther distant from one another than each is from median ocellus; distance between each compound eye and lateral ocellus about the same as between lateral ocellus and median ocellus.

Pronotum approximately quadrangular, broader than long, a distinct pattern of raised rugosities on surface each side of pale, median, longitudinal stripe, fig. 112.

Legs with first and second tarsal segments together shorter than third, first tarsal segment much longer than second.

Wings slightly suffused with brownish, veins uniformly dark brown.

Abdomen, fig. 112, with tenth tergite not cleft; subanal lobes recurved upwards and over tenth tergite and with prominent, long, sharply pointed tips; ninth sternite produced much beyond tip of abdomen and rounded behind; eighth sternite with a stubby lobe on posterior margin, fig. 112.

Length to tip of wings 13 mm; length to tip of abdomen 10 mm.

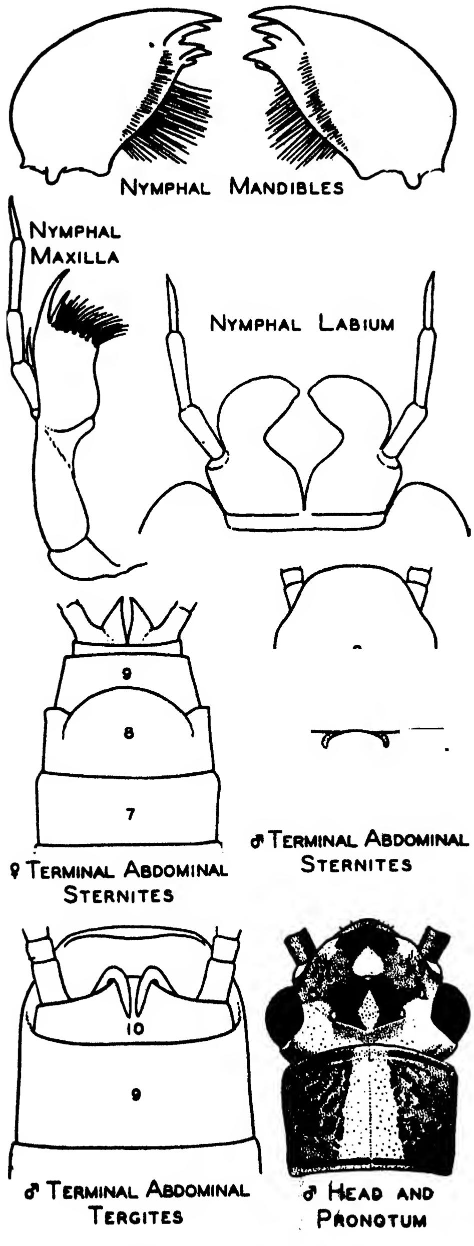


Fig. 112.—*Isoperla lata.*

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger

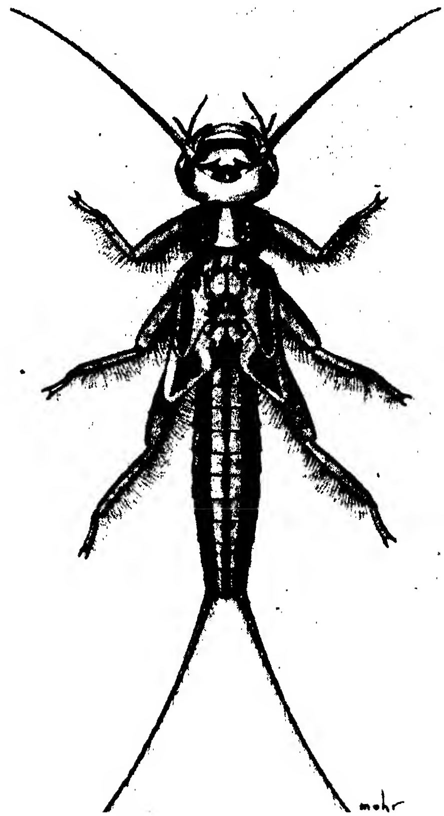


Fig. 113.—Nymph of *Isoperla lata.*

in size. Important differences are as follows: eighth abdominal sternite, fig. 112, with subgenital plate slightly produced over ninth sternite and broadly rounded.

Holotype, male.—Boulder Junction, Wis.: reared April 20, 1937, from nymph taken in small stream April 9, 1937, T. H. Frison & C. O. Mohr.

Allotype, female.—Same data as for holotype.

Paratypes. — WISCONSIN. — BOULDER JUNCTION: Same data as for holotype except reared April 30, 1937, 1♀.

MICHIGAN.—LOVELLS, north branch of Au Sable River: June 16, 1935, J. W. Leonard, 2♀. North of ST. IGNACE: May 11, 1940, T. H. Frison & H. H. Ross, 1♂.

QUEBEC. — LAURENTIDES NATIONAL PARK, Pikauba River: July 7, 1938, Charles Gauthier, 1♀.

NYMPH.—General color bright yellow with sharply contrasting black areas on

head, thorax and abdomen, as illustrated in fig. 113. Legs, antennae and anal cerci yellowish.

Head with ocelli forming an almost equilateral triangle, median ocellus very indistinct; basal segments of mouthparts extending out from side of head. Labium, mandibles and maxillae as in fig. 112; maxilla is particularly distinctive with its broad apical end and dense brush of stout setae in addition to the long, stout, curved outer process and much smaller, adjacent, inner spinelike process.

Pronotum broader than long with markings as in fig. 113.

Abdominal tergites having general background bright yellow with dark longitudinal stripes, as in fig. 113; some scattered, stout, short setae on tergites in addition to row on posterior margin of each segment. Cerci long, many segmented, segments progressively longer from base to apex; a longitudinal row of long, fine setae on dorsal surface of apical segments in addition to smaller spinelike ones encircling apex of each segment.

Approximately mature specimens with body length of 13 mm.

No thoracic, anal or submental gills.

Nymphal and exuvial records are as follows.

MICHIGAN.—PEACOCK, Little Manistee River: May 10, 1940, T. H. Frison & H. H. Ross, 1 exuvia. North of ST. IGNACE: May 11, 1940, T. H. Frison & H. H. Ross, 3 exuviae. HONOR, Platte River: May 10, 1940, T. H. Frison & H. H. Ross, 3 exuviae; May 27, 1939, T. H. Frison & H. H. Ross, 2 exuviae. RAPID RIVER, Rapid River: May 12, 1940, T. H. Frison & H. H. Ross, 1 nymph.

NOVA SCOTIA.—MOOSE RIVER: Aug. 21, 1939, T. H. Frison & T. H. Frison, Jr., 1 exuvia.

TENNESSEE.—GATLINBURG, Le Conte Creek: May 14, 1939, T. H. Frison & H. H. Ross, 1 exuvia.

The maxillae of the nymph and general features of the adult show that this new species belongs in that group or subgenus of *Isoperla* (*s.l.*) which includes *marlynia* Needham & Claassen (= *clio* of American authors); for *clio*, Needham & Claassen (1925) proposed the generic name of *Clioperla*. The nymph in life has a particularly strong contrasting pattern of dark markings on a bright yellow background which, coupled with the peculiar construction of the maxilla, makes *lata* a species that is easily recognized in this stage.

Isoperla trictura (Hoppe)

Perla trictura Hoppe (1938, p. 151). Original description, ♂, ♀.

This aberrant species was placed in *Perla* when originally described by Hoppe, but it probably is best placed in *Isoperla* (*s.l.*) and probably eventually will be given subgeneric status. Although Hoppe has given illustrations of the dorsal terminal abdominal segments of the male and ventral terminal abdominal segments of the female, I feel warranted in presenting new illustrations of these structures together with additional drawings to aid future identifications of this species, fig. 114. At one time, I had planned to describe this species as new, but fortunately discovered in time the description of Hoppe.

The typic series of Hoppe came from Washington. To these typic records I can now add the following records, based mostly upon material sent to me by Dr. William E. Ricker.

OREGON.—ALSEA RIVER, May 24, 1939, Pillow, 1♀. LACOMB: Crabtree Creek, June 4,

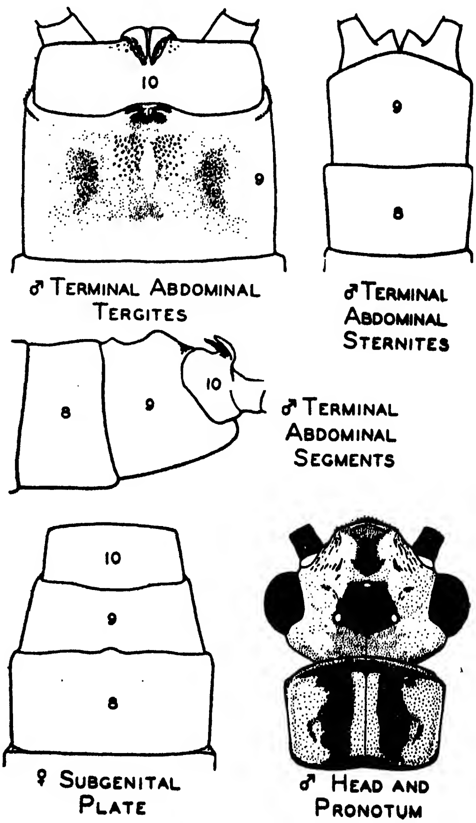


Fig. 114.—*Isoperla trictura.*

1935, R. Dimick, 1♂; Molalla River, June 13, 1938, S. G. Jewett, Jr., 1♂; Willamette River, May 26, 1938, C. Jensen, 1♀.

BRITISH COLUMBIA.—CULTUS LAKE: lower Sweltzer Creek, May 12, 1937, W. E. Ricker, 5♂, 2♀; Sweltzer Creek, June 4, 1937, Ricker, 3♂, 1♀; Chilliwack River, April 24, 1938, Ricker & Spencer, 2♂, 2♀; Chilliwack River, May 22, 1938, S. Spencer, 3♂. VEDDER CROSSING: May 5, 1937, W. E. Ricker, 1♀; May 19, 1937, W. E. Ricker, 3♂.

Isoperla pinta Frison

Isoperla pinta Frison (1937, p. 92). Original description, ♂, ♀, nymph.

Isoperla tokula Hoppe (1938, p. 157). Original description, ♂, ♀. New synonymy.

Through the kindness of Professor Trevor Kincaid of the University of Washington, I have had the privilege of studying the holotype, allotype and paratypes of *tokula*. This is the same species as *pinta*, and hence *tokula* must be placed in the synonymy of *pinta* on the basis of date priority.

Isoperla fulva Claassen

Isoperla fulva Claassen (1937*a*, p. 80). Original description, ♂, ♀.

Isoperla chrysannula Hoppe (1938, p. 156). Original description, ♂. New synonymy.

Isoperla cascadensis Hoppe (1938, p. 158). Original description, ♂, ♀. New synonymy.

A study of the types of *fulva*, *chrysannula* and *cascadensis* has convinced me that only one species of *Isoperla* is involved, which will take the name of *fulva* on the basis of date priority. The types of *fulva* have been studied through the courtesy of Dr. Henry Dietrich of Cornell University, and the types of *chrysannula* and *cascadensis* through the courtesy of Professor Trevor Kincaid of the University of Washington.

The typic specimen of *chrysannula* differs from the types of *fulva* and *cascadensis* in that the costal vein of the forewing is not connected with the radial vein. In view of agreement in all other respects, the frequency of variation in details of wing venation in general, and variation existing within the same species, it is my opinion that the absence of part of the tip of the costal vein in *chrysannula* is an instance of variation.

The description by Hoppe of *cascadensis* as a new species can be explained by the probability that Claassen's description of *fulva* was overlooked. This probability is indicated by the lack of any citation of this particular article in the bibliography given by Hoppe and by the lack of recognition of *fulva* from Washington, where it occurs. Claassen's paper appeared several months before Hoppe's paper was published and therefore has priority.

A study of the types of *cascadensis* has failed to reveal any characters which definitely separate the species from *fulva*. The lobe on the posterior margin of the eighth abdominal sternite is subject to variation in size, depending upon age of specimen and other factors. Hoppe's figures of the male eighth abdominal sternites of *chrysannula* and *cascadensis* would seem to indicate a wide difference in respect to size of the lobe on the posterior margin of this sternite, but such a great difference does not exist because of reasons just mentioned.

CHLOROPERLIDAE

Considerable confusion has resulted in stonefly literature, both in Europe and North America, because of the erroneous interpretation of the genotype of *Chloroperla* Newman (1836). Banks (1906*b*) was first to point out that *Isopteryx* Pictet (1841) was synonymous with *Chloroperla* Newman (1836) and to recognize that the *Chloroperla* of Pictet contained two previously unnamed genera for which he proposed the names of *Alloperla* and *Isoperla*. Kimmins (1936), in a recent study of the British species of *Chloroperla*, has confirmed the work of Banks in regard to synonymizing *Isopteryx* with *Chloroperla* and in proposing the new generic names of *Alloperla* and *Isoperla*. In addition, Kimmins has shown that the genotype of *Chloroperla* was established by Westwood (1840) as *C. tripunctata* (Scopoli) [= *C. lutea* (Latreille)].

Another source of trouble in North American literature has been an erroneous conception of the species described from Georgia by Newman (1839) under the name of *Chloroperla cydippe*. Ricker's (1938) comments and drawings, and additional information furnished to me through the kindness of D. E. Kimmins of the British Museum, prove that the typic specimens of *cydippe* are not of the species assigned to this name by Hagen (1861), Needham & Claassen (1925)

and others, and that *cydippe* belongs to the genus *Alloperla.*

The establishment of the fact that *cydippe* (Newman) belongs to the genus *Alloperla* makes *brevis* (Banks 1895) an available name for the species erroneously called *cydippe* by Hagen, Needham & Claassen and other north American writers since then. The possibility of such a usage I suggested in 1937, but no definite stand was taken in regard to this use of names at that time because the status of *cydippe* had not been definitely determined. Furthermore, the name of *Hastaperla* Ricker (1935*a*) now becomes available as the generic name for *brevis* (Banks), since the genotype of *Hastaperla* is an outright synonym of *brevis* (Frison 1937); and *Chloroperla,* on the basis of its genotype, must be associated with another group of closely related species. Along with *brevis,* the species *orpha* (Frison 1937) should now be placed in *Hastaperla.*

Ricker (1938) suggested the possibility that *Alloperla* Banks is synonymous with *Chloroperla* Newman. Basing my conclusions upon comparative studies of true specimens of *Chloroperla* from Europe named by Kimmins with North American specimens of *Alloperla,* I find that *Alloperla* should be accepted as a valid generic name for certain North American species, and probably some Asiatic species, now going by this name. My reasons for the recognition of *Alloperla* Banks as generically distinct from *Chloroperla* Newman are as follows: (1) in *Chloroperla* the hooked supra-anal process (see Kimmins 1936) of the male is not mounted on a large membranous base deeply recessed in the broadly cleft tenth abdominal tergite as is the case in *Alloperla,* and (2) the second anal vein of the forewing in *Chloroperla* does not appear branched as a result of fusion with base of third anal vein as is the case in *Alloperla.*

There is, however, a North American species of Chloroperlidae, recognized and described for the first time in succeeding pages of this article, which seems best placed generically in the genus *Chloroperla* Newman, as defined and used by Kimmins (1936). It is true that the male of this new species differs from the genotype of *Chloroperla* [*tripunctata* (Scopoli)] by the presence of a small projection on the seventh abdominal sternite, but its general habitus, small size, color pattern, wing shape and venation, and structure of terminal dorsal abdominal segments otherwise place it with or very near to *Chloroperla* (*s.s.*).

What has just been stated, when practically interpreted, results as follows: (1) *Isoperla* Banks is the valid generic name for a group of species [genotype *bilineata* (Say)] in North American literature now going under this name, and also for certain Eurasian species, many of which have been going under the generic name of *Chloroperla* (*i.e. Chloroperla* in the sense of Despax 1936); (2) *Chloroperla* is a valid generic name for certain European, and possibly Asiatic, species which have gone under the names of *Chloroperla* and *Isopteryx,* and for a new species from eastern North America described in this paper; (3) *Hastaperla* Ricker (1935*a*), as I suggested in 1937, becomes the generic name for two North American species, *orpha* (Frison) and *brevis* (Banks), the latter misidentified in most North American literature under the name *cydippe* (Newman); and (4) *Alloperla* is a valid generic name for certain North American species, and possibly some Asiatic species, now going by this name.

Admittedly, *Chloroperla, Hastaperla* and *Alloperla* are closely related, but from the standpoint of comparing the world fauna, there are advantages at present in considering them as distinct genera, at least until the Chloroperlidae of the world are better known. *Kathroperla* and *Paraperla,* belonging to this same family, are much more distantly related.

The removal of *Isoperla* from the Chloroperlidae, as done elsewhere in this paper, and the recognition in North America of the genus *Chloroperla* as defined by Kimmins (1936), warrants a new key for the separation of the genera of Chloroperlidae as follows.

KEY TO ADULTS, NORTH AMERICAN GENERA OF CHLOROPERLIDAE

1. Hindwing without a distinct folded anal lobe, fig. 115 .... **Hastaperla**
   Hindwing with a distinct folded anal lobe, figs. 116–118 2
2. Head much longer than pronotum; compound eyes situated far forward on sides of head so that the distance between each compound eye and front

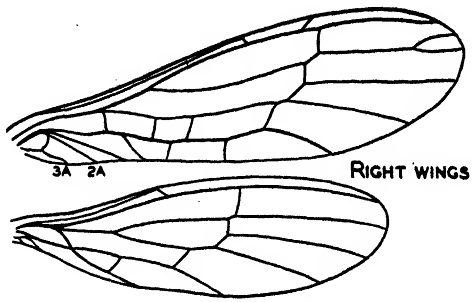


Fig. 115.—*Hastaperla brevis.*

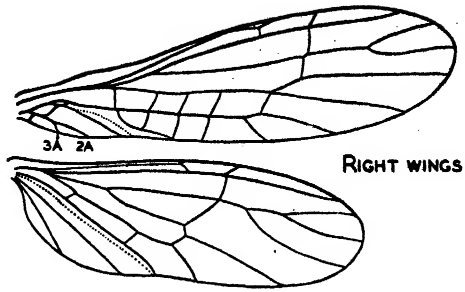


Fig. 117.—*Alloperla caudata.*

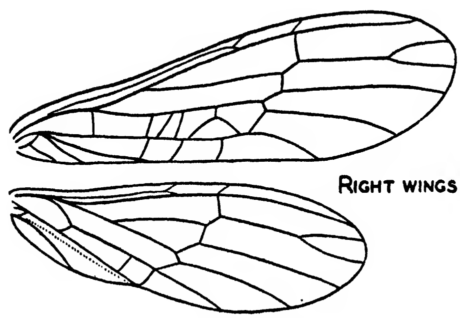


Fig. 116.—*Chloroperla terna.*

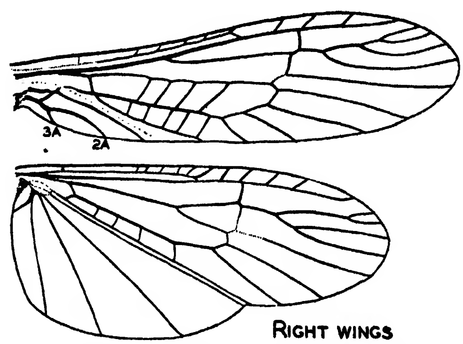


Fig. 118.—*Paraperla frontalis.*

margin of pronotum is at least twice as great as diameter of eye . . **Kathroperla**

Head shorter than in *Kathroperla*, but slightly longer than pronotum; compound eyes situated on sides of head about their diameter from front margin of pronotum 3

3. Third anal vein of forewing not present or, if present, not fused with second anal vein so that second anal vein appears branched, fig. 116 . . . . . . **Chloroperla**

Third anal vein of forewing with basal portion fused with second anal vein so that second anal vein appears branched, figs. 117–118 4

4. Anal lobe of hindwing small, in length extending about to middle point of wing, fig. 117; small, pale-colored species . . . . **Alloperla**

Anal lobe of hindwing large, in length extending well beyond middle point of wing, fig. 118; medium-sized, dark-colored species . . . . **Paraperla**

In *The Stoneflies, or Plecoptera, of Illinois* (Frison 1935*a*), the generic key for Chloroperlidae included the genera *Hastaperla* (= *Chloroperla* of North American authors) and *Isoperla*. *Isoperla* was inincluded in the key on the basis of actual records of numerous species from Illinois. *Hastaperla* was included because of the occurrence of the species *brevis* (Banks) (= *cydippe* of North American authors) in Indiana at a locality a few miles from the Illinois boundary line, and also because of the probability of its eventual capture in Illinois. In a later article (Frison 1937), giving additions to the Illinois stonefly faunal list, no new records of Chloroperlidae for Illinois were available, but a new species of *Hastaperla* was described from Wisconsin as *Chloroperla orpha*.

Since 1937, continued field work in Illinois in restricted local habitats has revealed actual Illinois material of the genera *Hastaperla* and *Alloperla*. Records of the Illinois specimens of *Alloperla caudata* Frison, *A. banksi* Frison and *Hastaperla brevis* (Banks) are given under my notes and descriptions of these species in following pages.

Chloroperla terna new species

MALE.—Head, thorax, abdomen, cerci, basal segments of antennae and most of legs dominantly a pale yellowish green; apical segments of antennae fuscous; localized black or fuscous markings on thorax and abdomen. Ocelli and compound eyes black. No gill remnants.

Head slightly wider through compound

eyes than width of pronotum; median ocellus located about on a line with anterior margins of compound eyes, lateral ocelli located well anterior to a line connecting posterior margins of compound

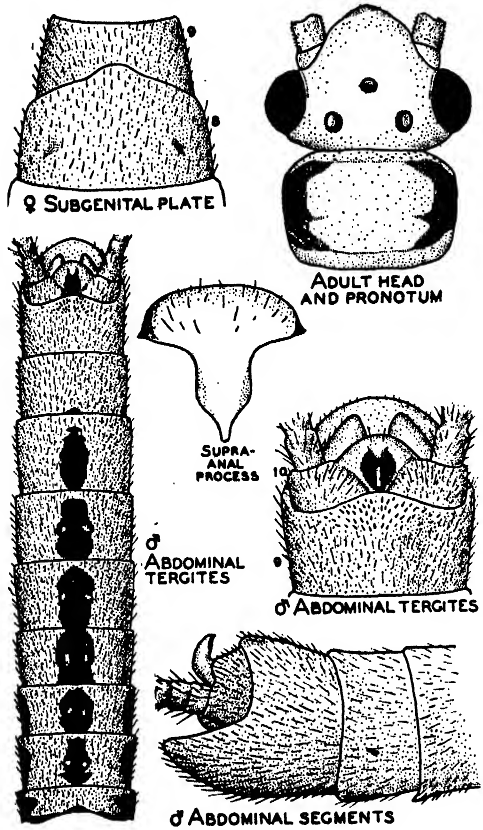


Fig. 119.—*Chloroperla terna.*

eyes, distance between lateral ocelli greater than distance between lateral ocellus and adjacent compound eye.

Pronotum much wider than long; lateral margins bordered with a wide black or a fuscous line, fig. 119. Legs yellowish green, except for fuscous tarsal segments.

Dorsum of abdomen with a median longitudinal series of fuscous spots forming a line from first to eighth tergite and with a shorter fuscous line on the lateral margins of the first three basal segments, fig. 119; supra-anal process or hook very small, dark colored at tip, shaped as in fig. 119, and but slightly inset or recessed on tenth tergite; seventh sternite with a small lobe in middle of posterior margin, fig. 119. Cerci short, composed of 7 to 8 segments several times longer than wide.

Wings extending well beyond tip of abdomen; with membrane and veins pale; a small anal lobe on hindwing, fig. 116; forewing with venation as in fig. 116.

Length to tip of wings 6 mm.; length to tip of abdomen 4 mm.

FEMALE. — Head, thorax, basal segments of abdomen and appendages in general similar to those of male but slightly larger in size. Differs in having eighth abdominal sternite with a slightly produced, rounded subgenital plate, fig. 119.

Holotype, male.—West Topsham, Waits River, Vt.: June 21, 1941, T. H. Frison & H. H. Ross.

Allotype, female.—Same data as for holotype.

Paratypes.—NEW YORK.—Small creek 3 miles west of KEENE: June 20, 1941, T. H. Frison & H. H. Ross, 1♂. EUBA MILLS, Adirondack State Park: June 20, 1941, T. H. Frison & H. H. Ross, 1♀.

TENNESSEE.—ELKMONT, Little Pigeon River: May 14, 1939, T. H. Frison & H. H. Ross, 1♂.

This minute species is particularly interesting since it resembles in color *Hastaperla orpha* (Frison) but structurally is best placed in the genus *Chloroperla* as defined by Kimmins (1936). The chief difference that I note between this new species in the male and *Chloroperla tripunctata* (Scopoli), the genotype, is the small lobe on the posterior margin of the seventh abdominal sternite. It differs from species of *Hastaperla* and *Alloperla* as indicated in the key to the adults of Chloroperlidae.

Hastaperla brevis (Banks)

Chloroperla brevis Banks (1895, p. 314). Original description.

Isopteryx cydippe Hagen (1861, p. 31). Misidentification.

Chloroperla cydippe Needham & Claassen (1925, p. 128).

Chloroperla cydippe Frison (1935*a*, p. 431).

In 1935, I included *brevis* under the name *Chloroperla cydippe* Newman, as a species likely to be found in Illinois because of its occurrence in Indiana just a few miles from the boundary line between these two states. In 1938, this species was first actually collected in Illinois and therefore is now to be definitely included in the faunal list of this state.

The illustration of the nymph (Frison

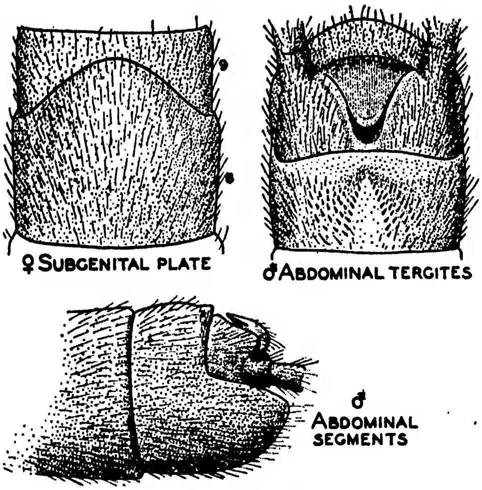


Fig. 120.—*Hastaperla brevis.*

1935*a*, fig. 331) is quite satisfactory, but the illustrations of the most important structural details of the adults are poor, and new ones, figs. 115 and 120, are herewith presented.

Specimens of this species, and records associated with them, have been studied as follows.

ARKANSAS.—BENTON, Salt Creek: April 15, 1939, H. H. & J. A. Ross, 1 nymph, 1♀. MALVERN, southwest of town: April 15, 1939, H. H. & J. A. Ross, 1♂. MOUNTAINBURG, Clear Creek: May 1, 1939, H. H. & J. A. Ross, 1♀. MOUNTAIN PINE: June 5, 1937, H. H. Ross, ♂♂, ♀♀. WASHINGTON COUNTY: May 3, 1939, 1♂. WINSLOW: May 1, 1939, H. H. & J. A. Ross, 1♂, 2♀.

ILLINOIS.—SHAWNEE NATIONAL FOREST, Union County, Hutchin's Creek: April 8, 1938, Frison & Mohr, 10 nymphs. MOUNTAIN GLEN, Union County, Hutchin's Creek, near town: April 24, 1938, C. O. Mohr, 7♂, 10♀, 1 nymph, 2 exuviae, 3♀ (reared). SERENA, Indian Creek: May 19, 1938, Ross & Burks, 2♀. WOLF LAKE, Union County, Hutchin's Creek: May 2, 1940, Mohr & Burks, 1 nymph; May 7, 1940, Mohr & Burks, 1♂ with 1 exuvia (reared); May 12, 1939, Burks & Riegel, 1♀, 1 nymph, 4 exuviae; May 14–15, 1940, Mohr & Burks, ♂♂, ♀♀; May 25, 1940, Mohr & Burks, 1♀.

INDIANA.—TURKEY RUN STATE PARK: May 30, 1930, Frison & Ross, 1♀; in gorge, May 22, 1932, T. H. Frison, 1♀; Newby Gulch, May 6, 1933, Mohr & Townsend, nymphs; May 11, 1933, Frison & Mohr, 6♂ (reared), ♂♂, ♀♀; Newby Gulch, May 11, 1933, Frison & Mohr, nymphs, ♂♂, ♀♀; reared at Charleston, Ill., May 12, 1933, Frison & Mohr, 1♂, 1♀; Newby Gulch, May 12, 1933, Mohr & Frison, nymphs; Sugar Creek, May 7, 1939, G. T. Riegel, 3 nymphs; small tributary stream, May 7, 1939, G. T. Riegel, 4 nymphs; Newby Gulch, April 9, 1940, Frison & Ross, 5 nymphs.

KENTUCKY. — CUMBERLAND FALLS STATE PARK: May 12, 1939, Frison & Ross, 1♀.

MANITOBA.—CHURCHILL: Aug. 3, 1937, D. Denning, 1♀; Churchill River, 20 miles south of town, Aug. 5–6, 1937, D. G. Denning, 3♂, 2♀; Aug. 2–9, 1937, D. G. Denning, 1♀; July 29, 1936, H. E. McClure, 1♂. PIGEON RIVER: June 10, 1932, F. Neave, 4 specimens. SWAN RIVER, Swan River: June 5, 1936, H. E. McClure, 3 nymphs.

MARYLAND.—BALTIMORE: May 16, 1938, E. G. Fisher, 1♂, 3♀. PINEY GROVE: April 19, 1938, H. H. Ross, 2 nymphs.

MICHIGAN. — BENZONIA: May 27, 1939, Frison & Ross, 1♂, 8♀. FREE SOIL, Great Sable River: May 26, 1939, Frison & Ross, 5♂, 3♀, 1 nymph, 4 exuviae. HALE, Au Sable River: May 21, 1936, Frison & Ross, 3♂. Near HALE, Au Gres River: May 21, 1936, Frison & Ross, 1♀, 3 nymphs. IRONS, Little Manistee River, near town: May 28, 1939, Frison & Ross, 4 nymphs. ISLE ROYALE: Aug. 3–7, 1936, C. Sabrosky, 1♀. MAYFIELD, Boardman River: May 28, 1939, Frison & Ross, 2♂.

MINNESOTA. — Enchanted Isle, LAKE MINNETONKA: June 25, 1932, H. H. Shepard, 1♀. GRAND MARAIS: Little Devils Track Creek, Aug. 8, 1929, C. T. Schmidt, 9♀; Devils Track Creek, Aug. 7, 1929, C. T. Schmidt, 1♀; Kadunce Creek, in spider web on rock cliff, Aug. 8, 1929, C. T. Schmidt, 1♀. No. 1,954, O. W. Oestlund collection, 1♀.

MISSOURI. — SPRINGFIELD, Pickerel Creek: May 20, 1937, H. H. Ross, 1♀. ZION, Madison County: April 7, 1938, Frison & Mohr, 1 nymph.

NEW YORK.—ITHACA: Coy Glen, July 7, 1908, 2 specimens; Wild Flower Preserve, July, 1929, 1♀. SPRAKERS, Flat Creek: July 3, 1934, 1♀. TOMPKINS COUNTY, Six Mile Creek: July 8, 1927, P. R. Needham, 1♂, 5♀. EUBA MILLS, Adirondack State Park: June 20, 1941, Frison & Ross, 1♂, 1♀. BLUE MOUNTAIN LAKE, Bear Brook near town, Adirondack State Park: June 19, 1941, Frison & Ross, 1♂.

NORTH CAROLINA.—MARION: April 23, 1939, Ross & Burks, 4♂, 2♀. SMOKEMONT, Oconaluftee River: May 29, 1934, T. H. Frison, 3♂, 3♀. STATESVILLE, April 23, 1938, Ross & Burks, 1♂, 1♀, 1 nymph.

NOVA SCOTIA.—MOSER RIVER: Lower Goldmine Brook (A1), June 22, 1939, J. A. C. Nicol, 10♂, 10♀; Goldmine Brook (B), June 23, 1939, J. A. C. Nicol, 5♂, 13♀; Goldmine Brook (A2), June 26, 1939, J. A. C. Nicol, ♂♂, ♀♀; Lower Goldmine Brook (A1), July 9, 1939, J. A. C. Nicol, 1♂; Lower Goldmine Brook (A2), June 19, 1939, J. A. C. Nicol, 1♂.

OHIO.—HOCKING COUNTY: May 1, 1938, D. J. & J. N. Knull, 1♀.

OKLAHOMA.—ALBION, Clear Creek: June 4, 1937, H. H. Ross, 11♀. FLINT: June 6, 1934, 1♂; June 8, 1934, 2♂, 1♀; June 19, 1937, Standish-Kaiser, 2♂, 1♀. LOCUST GROVE: May 5, 1934, 1♂, 2♀. PAGE: June 23, 1937, Standish-Kaiser, 1♂, 1♀. WILBURTON: June 4, 1934, 1♀; July 10, 1934, 1♂.

OREGON.—HORSETAIL FALLS, Columbia River Highway: Aug. 6, 1922, G. Hoppe, 2♂, 3♀.

[These specimens were originally recorded by Hoppe (1938) under the name *Chloroperla cydippe* Newman.]

ONTARIO.—Costello Lake, ALGONQUIN PARK, Ontario Fisheries Research Laboratory: Station 3, June 2, 1938, W. M. Sprules, 3♀; Station 3, June 17, 1939, 1♀; June 6, 1939, 1♂; June 8, 1939, 1♀; Station 4, June 12, 1939, 1♂; Station 6, June 7, 1939, 1♀; June 15, 1939, 1♀; June 6, 1939, 2♂; Station 7, June 9, 1939, 1♀.

TENNESSEE.—GATLINBURG: Fighting Creek, branch of Little Pigeon River, May 27, 1934, T. H. Frison, ♂♂, ♀♀; Little Pigeon River, June 12, 1935, H. H. Ross, 1♀; Le Conte Creek, May 14, 1939, Frison & Ross, 7♂, ♀♀; Le Conte Creek, June 14, 1940, T. H. Frison *et al.*, 6♂, 3♀; Pigeon River, June 14, 1940, T. H. Frison *et al.*, 1♀; June 14, 1940, T. H. Frison *et al.*, 1♀. PARKSVILLE: April 25, 1938, Ross & Burks, ♂♂, ♀♀. PIGEON FORGE: May 13, 1939, Frison & Ross, 1♂. TOWNSEND, Lynncamp Prong, Little River: May 15, 1939, Frison & Ross, 1♂.

VIRGINIA.—CURLEY'S NECK BRIDGE: April 19, 1938, M. E. Davis & D. T. Ries, 5♂, 2♀.

WISCONSIN.—BLOOMER: June 5, 1936, Frison & Ross, 2♂, 7♀. HAYWARD, Teal Creek: Aug. 5, 1932, T. H. Frison, 1♂. SPOONER, Namakagon River: June 5, 1936, Frison & Ross, 2 exuviae. TROUT LAKE: July 22, 1937, Frison & Ross, 1♂, 7♀.

Alloperla caudata Frison

Alloperla caudata Frison (1934, p. 27). Original description, ♂, ♀.

It is a source of satisfaction now to add to the Illinois list of stoneflies the species *caudata,* originally described from material collected in Oklahoma. Specimens of this species were first found in Illinois in 1939, after persistent field work in a small stream in southwestern Illinois long suspected of harboring some aquatic insects of rare occurrence in this state. In 1940, more thorough collecting and better seasonal timing produced numerous additional specimens of this species.

Although *caudata* is new to the Illinois list of stoneflies, there is no need to redescribe it. I do, however, wish to present as an aid to identification new and better illustrations, based mostly upon Illinois specimens, of the terminal abdominal segments of the male showing the supra-anal process and the subgenital plate of the female, fig. 121. Fig. 117 shows the wing.

The nymphs of the different species of *Alloperla* described to date, and others collected by me, are homogeneous in appearance, and *caudata* is no exception to this statement. Perhaps careful studies of reared material will eventually reveal some minute characters which will serve to distinguish some or all of the species of this genus. As in the case of *Allocapnia*, *Nemoura*, *Leuctra* and other genera which have homogeneous nymphs, it is sometimes possible to identify last stage nymphs because the color patterns and important genitalic features of the adults about to emerge are visible and recognizable through the nymphal skin.

A brief description of the nymph of *caudata* is as follows.

NYMPH.—General color of head, thorax, abdomen and appendages pale brown, without conspicuous bands, spots or stripes of contrasting colors, fig. 122.

Head with three ocelli forming a nearly equilateral triangle; distance between

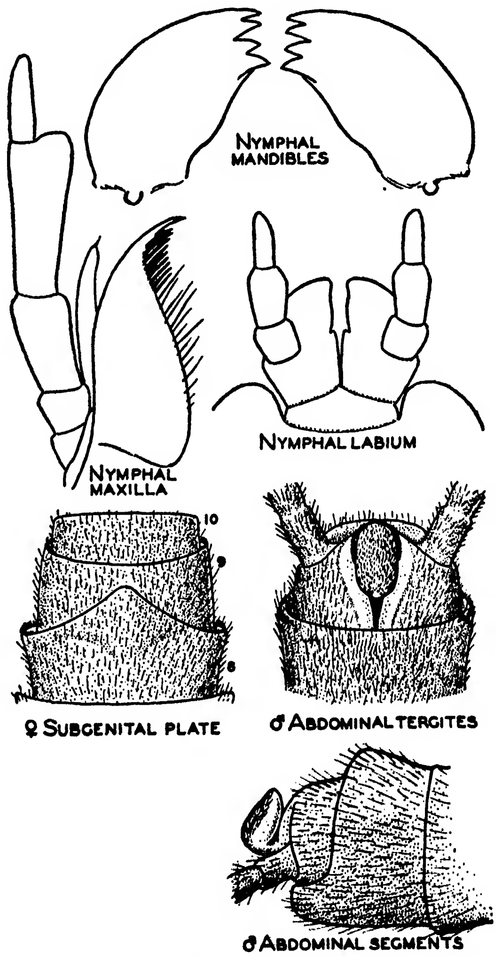


Fig. 121.—*Alloperla caudata.*

ocelli about the same as distance from a lateral ocellus to inner margin of compound eye; no occipital ridge; labium, maxillae and mandibles as in fig. 121.

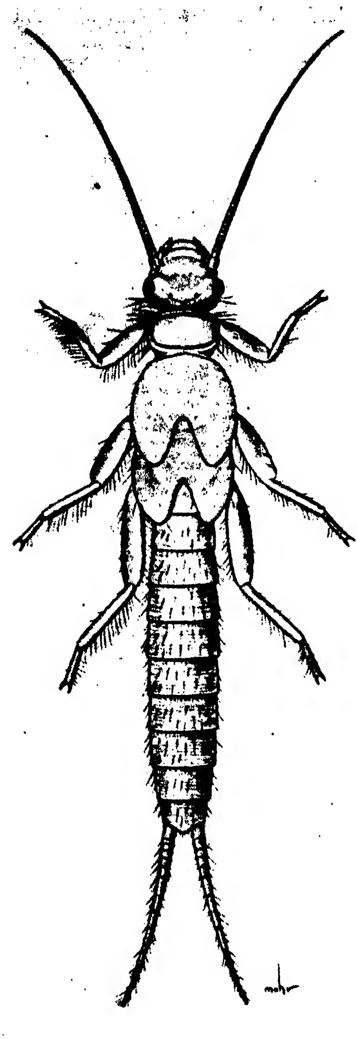


Fig. 122.—Nymph of *Alloperla caudata.*

Pronotum suboval, much wider than long. Wing pads on mesonotum and metanotum with lateral margins broadly rounded.

Gills entirely lacking.

New distributional records for this species, represented by material in the Illinois Natural History Survey collection, are as follows.

ILLINOIS.—LA RUE, near McCann School: May 26, 1938, B. D. Burks & G. T. Riegel, 1♂. Hutchin's Creek, near WOLF LAKE: May 12, 1939, B. D. Burks & G. T. Riegel, 1 exuvia; May 18, 25, 31, 1940, C. O. Mohr & B. D. Burks, ♂♂, ♀♀, nymphs and exuviae.

ARKANSAS.—MOUNTAIN PINE: June 5, 1937, H. H. Ross, 3♂, 6♀. Kings River, EUREKA SPRINGS: May 8, 1938, M. W. S., 1♀.

OKLAHOMA.—FLINT: June 6, 8, 1934, ♂♂, ♀♀; June 19, 1937, Standish-Kaiser, 3♂, 2♀.

Alloperla banksi new species

Alloperla nanina Needham & Claassen (1925, p. 126). Misidentification.

Alloperla nanina Frison (1935*b*, p. 341). Misidentification of Needham & Claassen suggested.

Under the discussion of *nanina* Banks attention is directed to the fact that Needham & Claassen (1925) misidentified *nanina*. This I first suggested (1935*a*) when I stated, "That there is another unnamed species without a dark dorsal abdominal stripe now going under the name of *nanina* is evident from the description of Needham and Claassen (1925) and the collection of such a female specimen by the author at Caroline, New York, in August, 1928." At that time, I further stated, "Action in proposing a name for these specimens without a dark dorsal abdominal stripe, now confused with *nanina*, is delayed pending the study of further material." Additional material of this species has now been collected and studied, and the time has arrived for actual naming and recognition of this species.

MALE.—Head, thorax, abdomen, cerci, basal segments of antennae and legs in general a pale yellowish green. Ocelli and compound eyes black. No gill remnants present.

Head slightly wider through compound eyes than width of pronotum; median ocellus located about on line with anterior margins of compound eyes, lateral ocelli located well anterior to line connecting posterior margins of compound eyes, distance between lateral ocelli greater than distance between a lateral ocellus and adjacent compound eye.

Pronotum much wider than long, angles rounded.

Dorsum of abdomen without a dark, dorsal, median stripe. Supra-anal process small, inset in cleft of tenth tergite, fig. 123; basal portion membranous and pale colored; small recurved tip, fig. 123, more sclerotized and brownish in color. Eighth and ninth tergites without raised ridges.

Cleft tenth tergite without inward-pointing lobes or hooks at bases of cerci.

Wings extending well beyond tip of abdomen; with membrane and veins pale; a well-formed anal lobe on hindwing and

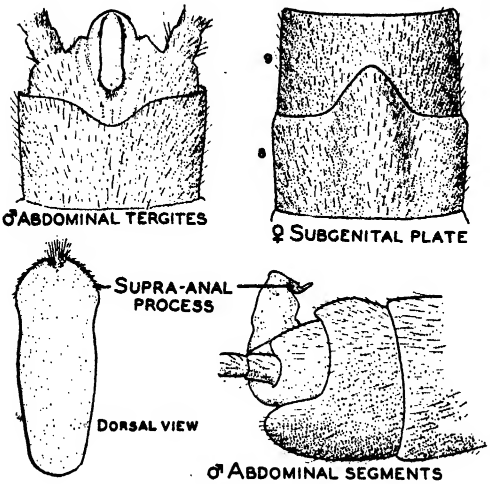


Fig. 123.—*Alloperla banksi.*

with venation typical of *Alloperla* as now recognized in North America.

Length to tip of wings 9 mm.; length to tip of abdomen 7 mm.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of male but slightly larger in size. Important differences are as follows: eighth abdominal sternite, fig. 123, with median posterior margin somewhat produced backwards over ninth sternite in the shape of a V.

Holotype, male.—FLAT CREEK, Flat Creek, N. Y.: July 3, 1935.

Allotype, female.—Same data as for holotype.

Paratypes.—NEW YORK.—FLAT CREEK: Same data as for holotype, 9♂, 5♀. VARNA: June 24, 1937, D. T. Ries, 1♀; June 26, 1937, Mary Davis & D. T. Ries, 1♀. Lloyd-Cornell Wild Flower Preserve, CAROLINE: Aug. 16, 1928, T. H. Frison, 1♀. CANAJOHARIE: July 12, 1934, 1♀. Susquehanna River, ONEONTA: July 5, 1935, 1♀. ITHACA: June 4, 1936, J. W. H. Rehn, 1♂ (A.N.S.).

ILLINOIS.—ROCK ISLAND: 1860, B. D. Walsh, 2♂ (M.C.Z.).

NOVA SCOTIA.—TRURO: June 26, 1913, R. Matheson, 4♂ (C.U.).

MICHIGAN.—Boardman River, MAYFIELD: May 28, 1939, T. H. Frison & H. H. Ross, 1♂.

The record of this new species from Illinois is most interesting since it is based upon two specimens collected by B. D. Walsh at Rock Island, Ill., in 1860. These specimens, found in the unidentified material of the Museum of Comparative Zoology, represent specimens sent to Hagen by Walsh associated with other material collected by the latter at Rock Island. Walsh's (1862) description of *Chloroperla nana* cannot refer to this species and probably is the same as *Isoperla minuta* (Banks) (see Frison 1935*a*, p. 282).

Dr. Nathan Banks kindly donated one of the two Walsh specimens of this new species to the Illinois Natural History Survey collection because of Walsh's early connection with one of the predecessor organizations of the present Survey and because the species was not represented in the Survey collection by Illinois specimens. Failure to find this species in the vicinity of Rock Island, Ill., within recent years may be due to some change in stream conditions where the species formerly existed. Many Illinois streams have undergone great changes during the past 80 years, and, with our present knowledge of the very localized habitats of some aquatic insects within the state, it is readily understandable how slight changes in several very small streams at the present time would eliminate several other species from the state. It is still possible, also, that the species may eventually be found in some small stream near Rock Island.

Alloperla nanina Banks

Alloperla nanina Banks (1911, p. 336). Original description, ♂, ♀.

Alloperla nanina Needham & Claassen (1925, p. 126). Misidentification.

Alloperla lodgei Frison (1935*b*, p. 340). New synonymy. Misidentification of Needham & Claassen suggested.

Alloperla nanina Frison (1935*b*, p. 341). Taxonomic comments.

In 1935 I called attention to the fact that Needham & Claassen (1925) had interpreted *nanina* as a species "without a dark dorsal stripe" on the abdomen, whereas, information from Banks indicated "that the type has such a stripe" and I reported that this also was the case with "a cotypic female received from Banks by the Survey in an exchange of material."

A restudy I made in 1939 of the typic series of *nanina* in the collection of the Museum of Comparative Zoology has revealed that Needham & Claassen (1925) were wrong in their concept of the species to be associated with the name of *nanina* and, influenced by their redescription, I (1935*b*) had redescribed *nanina* under the name of *lodgei.*

The cotypic series of *nanina* at Cambridge now consists of two males and two females (M.C.Z. No. 11,343). In ad-

dition to these, in the Illinois Natural History Survey collection is one cotypic female secured by exchange as noted above, and my notes indicate that another cotypic female is in the collection of Cornell University. It should be mentioned here that all of the cotypic specimens show traces of a faded dark dorsal stripe on the abdomen. Such a stripe is often difficult to see in old specimens, and this undoubtedly partly accounts for the misidentification of material by Needham & Claassen (1925).

Due to the kindness of Dr. Nathan Banks, I was permitted to relax one of the male cotypic specimens and place it in alcohol for closer study and comparison with a paratypic male of *lodgei* Frison. It is highly desirable that this male cotypic specimen in the collection of the Museum of Comparative Zoology, and now preserved in alcohol, be selected as the **lectotype**; I now so designate it.

The cotypic specimens of *nanina* all came from "Black Mountain, North Carolina, north fork of the Swannanoa River, May." The 17 specimens comprising the typic series of *lodgei* (= *nanina*) all came from "Fighting Creek, branch of Little Pigeon River, Gatlinburg, Tennessee, May 27, 1934," which is in the same general region.

Since then, I have added the following records.

TENNESSEE.—PARKSVILLE: April 25, 1938, H. H. Ross & B. D. Burks, 2♂, 1♀. GATLINBURG, Fighting Creek Gap: May 15, 1939, T. H. Frison & H. H. Ross, 6♂, 7♀ (1♀ reared).

Alloperla neglecta Frison

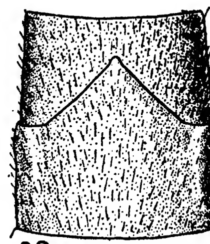
Alloperla neglecta Frison (1935*b*, p. 336). Original description, ♂.
Alloperla concolor Ricker (1935, p. 256). Original description, ♂, ♀. New synonymy.

Thanks to Dr. W. E. Ricker, I have had an opportunity to study the terminal abdominal segments of the holotypic male of *concolor* belonging to the Royal Ontario Museum of Zoology, Toronto, Canada. The study of the holotype confirms earlier suspicions that *concolor* is specifically identical with *neglecta* and therefore is a synonym of the latter species, which has date priority. Dr. Ricker in a letter to me states that he concurs with my opinion concerning this synonymy.

This species was originally described from the male sex only and was based upon material from "New Found Gap, North Carolina, 3560 ft. elevation, May 28, 1934 (T. H. Frison)." Since then additional material, including the undescribed female, has been taken in the same general locality and its description is now presented.

FEMALE.—Head, thorax, basal abdominal segments and appendages in general similar to those of the male (Frison 1935*b*, p. 336) but slightly larger in size. In life, specimens are a pale apple green.

Fig. 124.—*Alloperla neglecta.*



Important differences are as follows: eighth abdominal sternite, fig. 124, with posterior margin produced backwards in a V over ninth sternite.

Allotype, female.—Gatlinburg, Tenn., flying over road to Newfound Gap where it runs adjacent to West Prong Little Pigeon River: June 14, 1940, T. H. Frison *et al.*

Female specimens were taken at the same time and place as males, and since only three or four species differently colored were on the wing at the time there is no doubt of the correct association of this female as *neglecta.*

Additional records for this species are as follows.

NEW YORK.—ESSEX COUNTY, Artist's Brook: June 23, 1940, H. Dietrich, 2♂, 1♀. MOUNT MARCY: June 29, 1940, H. Dietrich, 3♂. ULSTER COUNTY, Slide Mountain: June 16, 1940, H. Dietrich, 3♂, 2♀. UNDERWOOD: June 22, 1940, H. Dietrich, 1♀.

PENNSYLVANIA.—SWIFTWATER, Monroe County: 1928, F. R. Nevin, Lot 258, 2♂, 5♀.

TENNESSEE.—GATLINBURG: June 14, 1940, T. H. Frison, *et al.*, 1♂, 5♀. NEWFOUND GAP, Little Pigeon River: May 14, 1939, Frison & Ross, 22♂, 1 exuvia, 1♂ (reared).

Alloperla novascotiana Needham & Claassen

Alloperla novascotiana Needham & Claassen (1925, p. 113). Original description, ♂.

This species has not been recorded since it was first described in 1925 from a single male specimen collected at "Truro, Nova Scotia." Recently, additional material, including the previously undescribed female, has been studied and the following description and records are therefore presented.

FEMALE. — Head, thorax, basal segments of abdomen and appendages in general similar to those as described for the male (Needham & Claassen 1925), except general color is more brownish. Important differences are as follows: eighth abdominal sternite, fig. 125, with posterior margin produced backwards over ninth sternite, its tip somewhat truncate.

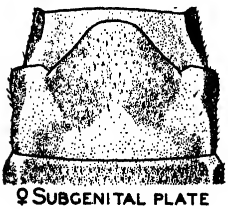


Fig. 125.—*Alloperla novascotiana.*

Allotype, female.—Essex County, Artist's Brook, N. Y.: June 23, 1940, H. D. Dietrich.

New records for this species are as follows.

NEW YORK.—COLD BROOK: June 30, 1940, H. Dietrich, 1♀. ESSEX COUNTY, Artist's Brook: June 23, 1940, H. Dietrich, 3♂, 10♀. MOUNT MARCY: June 29, 1940, H. Dietrich, 1♂, 1♀.

PENNSYLVANIA.—SWIFTWATER, Monroe County: 1928, F. R. Nevin, Lot 258, 2♀.

Alloperla fidelis Banks

Alloperla fidelis Banks (1920, p. 323). Original description, ♀.

It seems desirable to record here a series of adults with brachypterous wings, both males and females, which are apparently of the species *fidelis.* The only differences noted between the typical *fidelis* and these specimens are the smaller average size, the short wings in both sexes, a slight difference in shape of the indention on the posterior margin of the subgenital plate in the female, and the somewhat narrower supra-anal process of the male. These are the first specimens of *Alloperla* I have ever seen which were brachypterous, but Ricker (1939) has recorded brachypterous forms of the same species from small creeks at high elevations in British Columbia. It is of interest to note that both sexes in these specimens are short winged, whereas in many species of stoneflies this condition occurs or is reported to occur only in the males.

The specimens have the following data.

WYOMING.—DUNRAVEN PASS, Mount Washburn, Yellowstone National Park: Aug. 2, 1940, T. H. Frison & T. H. Frison, Jr., 5♂, 32♀.

In fig. 126 are illustrations of these specimens as follows: dorsum of male abdomen, lateral view of male terminal abdominal segments, supra-anal process of male, subgenital plate of female, and head and pronotum.

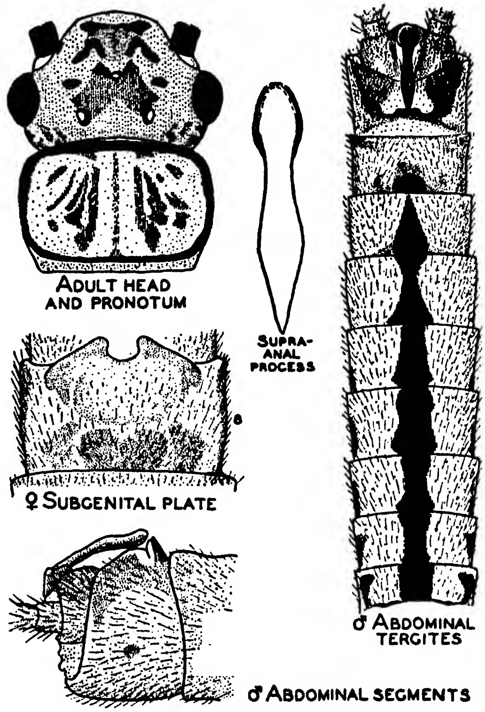


Fig. 126.—*Alloperla fidelis.*

Alloperla pallidula (Banks)

Chloroperla pallidula Banks (1904, p. 99). Original description, ♀.

Alloperla dubia Frison (1935*b*, p. 338). Original description, ♂, ♀. New synonymy.

In 1935, I described *dubia* as a new species closely related to *pallidula* and differing from it in having a median, longitudinal, dorsal, dark stripe on the abdomen. Although Needham & Claassen (1925) had treated *pallidula* as a species with this dark stripe, I had disregarded their concept of this species because of information from Dr. Nathan Banks that *pallidula* did not have such a stripe, and there was no indication in the original description of such a stripe on the typic specimen.

A recent study of the typic female of *pallidula* in the collection of the Museum of Comparative Zoology has revealed that, although faded and barely distinguishable, the type of *pallidula* does have the dorsal, longitudinal, dark stripe on the abdomen, as Needham & Claassen (1925) stated. Although females of *Alloperla* are not as satisfactory as males for purposes of specific recognition, I have come to the conclusion that *pallidula* and *dubia* are the same species and therefore the name *dubia* should fall in synonymy upon the basis of priority.

This paper is also the proper place to correct another statement made by me in my 1935*b* paper involving *dubia*. At that time, I recorded that three specimens of the "Aug., Estes Park, Colo." material recorded by Needham & Claassen (1925) were without a dark dorsal stripe on the abdomen "and hence agree with the true *pallidula* Banks," as I then accepted it. A restudy of these specimens reveals that this stripe was originally present but is now barely distinguishable because of fading or bleaching in preservative. Recently, Hoppe (1938) recorded both *pallidula* and *dubia* from Washington, but a check of her material named as these two species reveals that only one species—*dubia*—is involved. In other words, there is now no evidence that a western species exists which is structurally like *pallidula* but that differs in lacking the dark dorsal abdominal stripe.

Alloperla diversa Frison

Alloperla diversa Frison (1935*b*, p. 333). Original description, ♂, ♀.

Alloperla nimbilis Hoppe (1938, p. 155). Original description, ♂. New synonymy.

A study of the male type of *nimbilis*, through the courtesy of Professor Trevor Kincaid of the University of Washington, has revealed that it is practically identical with the male type of *diversa*, described from Oregon. The supra-anal process may differ slightly, but certainly no differences exist to warrant separate specific recognition, in the absence of other characters. Hoppe did not record *diversa* from Washington, and no mention is made in the original description of *nimbilis* of differences from or similarities to *diversa*.

Alloperla chloris Frison

Alloperla chloris Frison (1934, p. 27). Original description, ♂, ♀.

Chloroperla milnei Ricker (1935, p. 198). Original description, ♂, ♀. New synonymy.

A restudy of a paratypic specimen of *milnei* in the Illinois Natural History Survey collection and the cleared terminal abdominal segments of another paratypic specimen sent to me by Dr. W. E. Ricker on loan from the Royal Ontario Museum of Zoology, Toronto, Canada, has revealed that *milnei* is a synonym of *chloris*. Dr. Ricker states in a letter to me that he concurs with my opinion regarding this synonymy.

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Bold face type indicates a principal reference. Both principal and subsidiary references may occur on the same page. A species name appearing in the heading or bibliographic subheading of a description is indexed for the page on which it first occurs and not again in that description.

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Management of Small Artificial Lakes

A Summary of Fisheries Investigations, 1938–1942

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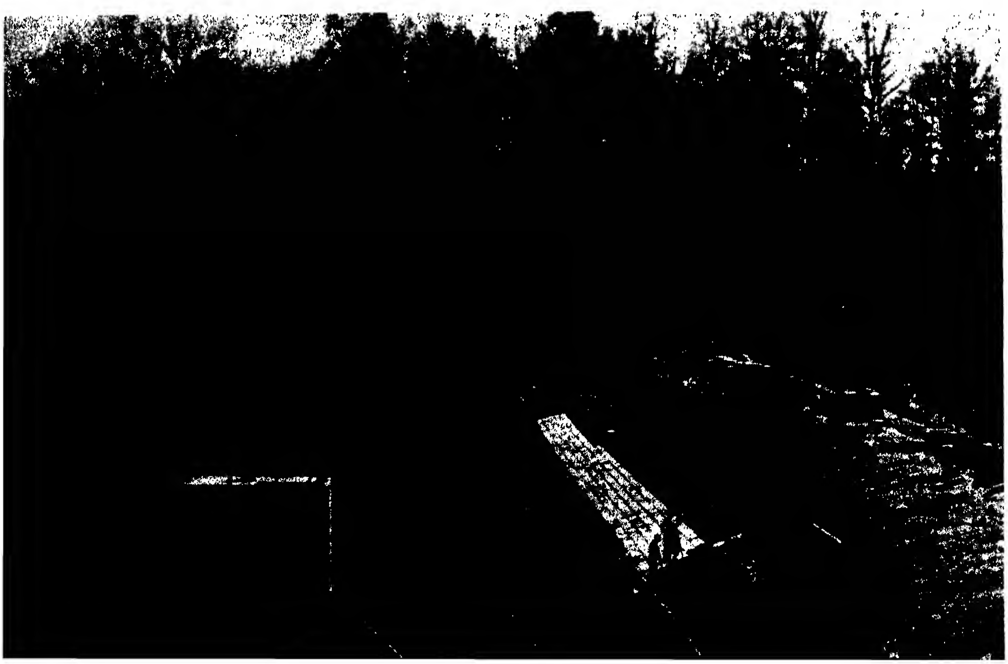
Above, Illinois Natural History Survey laboratory and instrument pier on Ridge Lake, Fox Ridge State Park, near Charleston, Ill. This new 18-acre artificial lake is an experimental area for limnology and fish management studies. The laboratory is equipped for many phases of lake work and also furnishes living quarters for Survey technicians. The instrument pier, in lake at left, houses recording instruments for air and water temperatures, a rain gage, a water level recorder, and wind direction and velocity indicators. Ridge Lake, which was stocked in the spring of 1941 with largemouth bass only, was opened to public fishing in 1942.

Below, the dam and outlet tower at Ridge Lake, April, 1941, when the lake was beginning to fill. The tower was designed to take care of small rises of water. The water enters the tower at its base, and, when the lake level reaches a point about 3 feet from the top of the tower, the water spills over a partition in the tower and flows through a concrete tunnel to the other side of the dam. A surface spillway (not shown in illustration) carries off flood waters. A valve at the base of the tower allows the lake to be completely drained. The face of the earth dam is shown being rip-rapped with concrete blocks to prevent washing.



Management of Small Artificial Lakes

A Summary of Fisheries Investigations, 1938-1942

GEORGE W. BENNETT

THE management of lakes for fishing should not be confused with fish culture as generally practiced in the United States. Lake management may require the products of fish culture, but its concept is much broader in that it attempts to discover and apply fundamental biological principles and relationships associated with fishes in natural or artificial waters, with the practical object of increasing fish yields and maintaining them. While current literature dealing with the physical, chemical and biological aspects of fish environment is voluminous, little is known concerning the ecological interrelationships of the fishes themselves, and this field offers a great deal of promise to those investigators who are called upon to find a solution to the ever increasing fishing pressure of a recreation-minded public.

Artificial lakes, although often lacking some of the scenic beauty of natural waters, can be made attractive as centers of recreation throughout much of our country. From the standpoint of fish management, they have an advantage over natural waters in that they are usually smaller, and often can be drained or otherwise rid of undesirable fish. However, large natural lakes as well as large artificial lakes are practically beyond the scope of the fish manager, once they become filled with undesirable fish. Large-scale netting operations on such waters may reduce the numbers of these undesirable species, but offer little assurance of permanent improvement.

The material in this paper includes information from several sources. That gathered by Dr. David H. Thompson, Illinois Natural History Survey Zoologist, and the author, from censusing the fish of 22 small artificial lakes in Illinois has been of great value in determining the kinds of fish suited to this type of habitat. It has also revealed some of the causes for poor fish yields, as well as information on the compatibility of various species. Angling records supplemented by hoopnet samples from several lakes provide a means of measuring the effects of underfishing and overfishing on fish populations. The case histories of many experimental lakes in which various combinations of fishes have been stocked suggest the degree of usefulness of the different combinations in fish management.

Objectives of Fish Management

The primary objective of fish management is to produce and maintain "good fishing." A definition of "good fishing" should include the element of numbers of fish caught per unit of time or effort, as well as that of size of individual fish. Numbers and sizes can hardly be defined satisfactorily for all cases, because of variation in the kinds of fish involved as well as in desires of the fishermen. However, the fish manager has need of some criterion useful (although not entirely satisfactory) in comparing the "goodness" of fishing waters. There is some agreement on the criterion of numbers placed at one fish per man-hour. In Illinois, where nearly all catches are bass, crappies, sunfish (centrarchids) or catfish, we have defined "desirable size" for several common species (Bennett, Thompson & Parr 1940, p. 3).

This represents approximately the minimum size for table use. For example, in the bluegill this minimum has been set at 6 inches total length or about 0.25 pound; in the crappie, 8 inches or about 0.30 pound. A suggested definition of a good fishing lake is one which produces an average catch of one fish of desirable size per man-hour of effort during the fishing season, and one which will maintain this rate year after year. Swingle & Smith (1938) in their *Management of Farm Fish Ponds* and in other publications (1939, 1941, 1942) say little about maintaining sustained yields, except through periodic draining and restocking.

The fish manager should have some knowledge of the carrying capacities of his lakes, and the kinds of fish that are present, as well as the intensity of fishing pressure. He can assume through experience some reasonable poundage figure (based on normal increment of the fish and carrying capacity of the lake) for cropping each lake, to serve as a guide in the yearly harvest of fish. Only by controlling the fishing pressure within a minimum range around the actual optimum yield can he have any assurance of sustained good fishing. Moreover, he should have the ability not only to recognize, but to control, certain outside influences which may limit or upset his planned yield. For example, the introduction of rough fish, such as carp and buffalo, through use of bait minnows may in time so restrict the size and abundance of hook-and-line species as greatly to reduce the yearly catch.

The importance of rough fish in limiting good fishing in artificial lakes has often been underestimated or overlooked. When carp or buffalo gain entrance into these lakes, they greatly influence the success of more desirable kinds. A change in the status of the game-fish population may come about through disturbance during the spawning period of the nest-building fishes, or rough fish may cause (through greatly increased turbidity) such a modification of the environment that it becomes unsuitable to the game and pan fish. Roily artificial lakes in Illinois invariably contain many rough fish or bullheads and small numbers of stunted crappies and sunfish. In lakes containing large populations of rough fish, additional stocking of centrarchids will not improve fishing. When the rough fish are entirely removed, the lakes become clear, and there is a marked improvement in size, condition and numbers of the game-fish population.

In some waters poor fishing may be due to an abundance of so-called forage fish, those species that are popularly supposed to serve as food for the desirable game fish. How these limit the numbers of more desirable fish is unknown, but crowding and food competition may be important factors.

Popular misconceptions have led Illinois fishermen or their organizations to insist upon the introduction into artificial lakes of several species of valuable fishes that are not suited to this environment. The most common fishes of this classification are the smallmouth bass and white bass. Other important fishes somewhat less commonly stocked are the walleyed-pike, northern pike, lake trout and muskellunge—the lake fishes of the north. The warm water and low oxygen concentrations seasonally characteristic of artificial lakes insure the early death of such fish. In a few instances in which they managed to survive for a time, they were unable to reproduce successfully.

There are, however, a few species of warm water fish apparently well suited to artificial lakes; these include largemouth bass, crappies, bluegills and bullheads. Upon these the Illinois lake fisherman must depend for angling. Yet problems arise when these fish are used, because of their great reproductive potential and the lack of natural predators. Stunting is the most common cause for poor fishing in artificial lakes stocked with these species. Although the largemouth bass is the most predatory of these fish, it seems unable to control populations of bluegills and crappies without the assistance of heavy hook-and-line fishing.

Evaluation of Species

More than 40 species of fish were found in 22 artificial lakes of Illinois in the course of censusing their fish populations. While most of these lakes furnished little or no fishing for a time previous to renovation, several represented average fishing waters, and a few were producing excellent catches. Past yield and stocking records are vague for many of these lakes. Such information may be gathered from lake owners or fishermen, but at best it is

somewhat inaccurate. In a few instances the censuses correlated nicely with verbal historical information. Usually, however, the older waters had been stocked so many times, and from so many sources, that it was impossible to determine the origin of their fish. In a few instances this historical information indicated that unfavorable changes in fishing had taken place within the past 5 or 6 years; earlier these lakes had produced good fishing, but gradually had changed until they produced little or none.

A perusal of fish censuses of the 22 lakes gives information not only as to what species do well in artificial lakes but also something of their potential value in fish management. For example, if green sunfish, *Lepomis cyanellus* Rafinesque, were found in nearly all lakes, but never of sizes large enough to interest fishermen, it might be conceded that stocking this fish in other artificial lakes would offer little in return for the effort. With the purpose of making a rough evaluation of common fishes, the censuses were carefully studied.

Tables 1 and 2 present a partial summary of these lake censuses. Table 1 lists the lakes and ponds with the composition of their fish populations for more common species given as per cents of total weight of fish. Table 2 lists the same lakes and ponds with their locations, areas, types of basins, transparencies in feet at the time their fish populations were removed, and the total poundage of fish removed per acre.

The status of the more important species could have been expressed in table 1 as per cents of the total populations by numbers instead of by weights, but it is felt that the use of weights rather than numbers gives a better indication of the importance of individual species.

The designation of "old" and "new" under types of basins in table 2 is as follows: "New" lakes and ponds are less than 5 years old, while "old" are from 5 to 50 years. The transparencies listed in the next column are only relative, as considerable variation may be found during any year. However, it may be seen that there is some correlation between low transparencies given in table 2, and high percentages of carp, buffalo, bullheads and gizzard shad, listed in table 1. The column "Total Weight of Fish, Pounds per Acre," table 2, is the result of dividing the total poundage of fish taken from the lake by its surface area in acres. It will be noted that the older waters usually support the higher poundages of fish and that lakes containing large percentages of rough and forage fish show greater poundages than those containing mostly desirable fish.

In the following paragraphs, important species are considered separately and on the basis of the census work outlined in tables 1 and 2. The status of each species was determined in each lake where it occurred, and each species was considered in relation to other species present. The arrangement of these fish in the following paragraphs is not systematic.

Largemouth Bass

Huro salmoides (Lacépède)

Contrary to general belief, the largemouth bass does not require a habitat of large size. It was found in 18 of the 22 Illinois lakes censused, and the bass populations averaged better in small than in large lakes, both in numbers and in size of individuals. Population densities varied from a fraction to 129 fish per acre of water. In five lakes, the bass population made up from 14 to 25 per cent of the weight of the total fish population. Only one of these five lakes contained more than a very few rough fish. Forage fish were present in only one of the three lakes containing the highest percentages of bass. Bass made up 25 per cent of the total population (by weight) in a lake that was overfished. Here angling was restricted during the spawning season, but intensive at other times.

In the 13 other lakes in which they were found, bass were less numerous. By weight they represented less than 4 per cent of the fish populations. All of these lakes contained large poundages of rough fish and forage fish (gizzard shad, golden shiners and other minnows) and all but three contained large populations of crappies. Most of these lakes were muddy throughout the year.

Successful largemouth bass populations were found in clear water. Repeated stocking of bass in muddy lakes containing large numbers of rough fish did not increase the bass population permanently. Small bass populations are frequently asso-

Table 1.—Composition of the fish populations of the lakes listed in table 2; for each important species of fish is recorded its per cent by weight of the total fish population of each lake.

Body of Water	Largemouth Bass	Smallmouth Bass	White Crappie	Black Crappie	Bluegill	Warmouth Bass	Green Sunfish	Pumpkinseed Sunfish	Orange-Spotted Sunfish	Yellow Perch	Yellow Bass	Black Bullhead	Yellow Bullhead	Speckled Bullhead	Carp	Redmouth Buffalo	Mongrel Buffalo	Smallmouth Buffalo	Gizzard Shad	Golden Shiner
Weldon Springs Lake	2.9	—	3.6	2.4	2.2	—	tr.	—	tr.	tr.	—	9.3	tr.	—	18.4	—	2.7	—	56.4	tr.
Southside Country Club Lake	2.2	—	3.0	2.7	4.1	tr.	tr.	tr.	—	tr.	2.8	tr.	tr.	tr.	8.6	2.5	1.5	tr.	65.1	5.3
Lower Twin Lake	3.5	—	6.1	4.4	20.3	1.0	tr.	—	—	—	—	tr.	tr.	—	—	13.4	11.4	37.3	—	1.6
Homewood Lake	2.3	—	5.0	2.2	12.4	tr.	1.3	tr.	tr.	tr.	1.2	tr.	tr.	—	18.8	14.7	1.8	—	26.3	1.3
Fork Lake	1.1	—	2.0	—	tr.	tr.	2.1	—	tr.	—	—	40.6	—	—	7.9	37.8	tr.	—	—	5.1
Farmer City Golf Course Lake	3.0	—	tr.	tr.	5.4	tr.	tr.	tr.	tr.	—	—	3.2	tr.	—	26.3	—	—	—	50.1	tr.
Edwards Pond	—	—	—	5.9	—	—	4.8	—	—	—	—	73.4	tr.	—	1.4	—	—	—	—	14.3
Upper Twin Lake	14.8	—	11.0	4.1	26.1	tr.	tr.	—	—	—	—	2.0	1.5	—	—	—	11.9*	5.9†	—	21.2
Crystal Lake Club No. 1 Lake	tr.	—	4.1	tr.	3.9	—	tr.	—	—	—	—	47.3	—	—	32.0	—	—	—	—	5.3
Black Jack Lake	tr.	—	tr.	tr.	2.6	tr.	1.6	—	—	—	—	38.8	tr.	—	42.1	9.7	2.3	—	tr.	tr.
Delta Pond	21.0	—	28.0	—	40.4	10.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kline's Lake	—	4.3	—	—	—	—	13.1	—	—	—	—	70.0	tr.	—	tr.	—	—	—	—	—
Jack's Lake	tr.	—	38.4	—	tr.	—	20.3	—	—	—	tr.	5.0	—	—	6.5	—	—	—	—	27.7
Shell Lake	—	tr.	1.9	24.9	6.4	—	2.8	—	—	—	—	62.9	—	—	—	—	—	—	—	—
Onized Lake	24.6	—	—	tr.	52.7	6.5	1.5	—	—	—	tr.	tr.	8.4	—	2.7	—	—	—	—	1.6
Waltonian Pond	18.9	—	—	—	20.7	—	57.3	tr.	—	—	—	—	—	—	—	—	—	—	—	—
Buck's Pond	tr.	—	tr.	tr.	tr.	—	tr.	—	tr.	—	—	5.6	tr.	—	16.1	72.8	4.4	tr.	tr.	—
Crystal Lake	—	—	—	1.3	tr.	—	tr.	—	tr.	—	—	4.0	tr.	—	92.6	—	—	—	—	tr.
Duck Pond, Pollywog Association	3.0	tr.	2.2	tr.	8.3	1.1	tr.	—	—	tr.	tr.	tr.	tr.	—	17.2	—	—	—	60.7	tr.
Triangle Pond, Pollywog Association	3.9	—	1.5	tr.	20.1	1.5	tr.	tr.	tr.	tr.	—	tr.	tr.	—	23.3	—	—	—	48.3	tr.
Duck Island Farm Lake	3.1	—	12.3	tr.	3.0	tr.	tr.	—	tr.	tr.	tr.	1.0	tr.	tr.	17.9	49.8	tr.	tr.	8.2	tr.
Sportsmen's Lake	13.8	—	9.8	tr.	6.8	tr.	tr.	—	tr.	tr.	tr.	tr.	tr.	—	1.4	37.2	5.1	tr.	15.2	tr.

tr. = less than 1 per cent. * 2 individual fish. † 1 individual fish.

Table 2.—A summary of the fish censuses of 22 artificial lakes in Illinois, showing lake areas, types of basin, transparency of water, and total poundages of fish collected per acre.

Body of Water	Location	Surface Area, Acres	Type of Basin	Transparency, in Feet*	Total Weight of Fish, Pounds per Acre
Weldon Springs Lake	Near Clinton	12.10	Old reservoir	—	409
Southside Country Club Lake	Near Decatur	8.40	Old reservoir	—	719
Lower Twin Lake	Near Decatur	1.36	Old pond	1.7	778
Homewood Lake	Decatur	2.83	Old pond	1.5	699
Fork Lake	Near Mount Zion	1.38	Old pond	0.6	539
Farmer City Golf Course Lake	Farmer City	0.75	Old pond	1.2	455
Edwards Pond	Near Kincaid	1.00	Old pond	1.0	398
Upper Twin Lake	Near Decatur	1.08	Old pond	0.5	392
Crystal Lake Club No. 1 Lake	Illinois, near Burlington, Iowa	0.75	Old pond	—	358
Black Jack Lake	Illinois, near Burlington, Iowa	4.00	Old pond	—	280
Delta Pond	Jonesboro	0.80	New pond	4.0	234
Kline's Lake	Near Le Roy	1.30	New pond	2.0	230
Jack's Lake	Near Decatur	1.50	New pond	2.3	221
Shell Lake	Near Clinton	1.50	Old pond	0.7	215
Onized Lake	Near Alton	2.14	Old pond	2.5	206
Waltonian Pond	Near Rudemont	1.10	New pond in forest land	3.0	71
Buck's Pond	Near Monticello	8.60	Old oxbow	0.5	1,145
Crystal Lake	Urbana	6.30	Old oxbow	0.8	658
Duck Pond, Pollywog Association	Near Oakwood	3.10	Old strip mine	2.2	673
Triangle Pond, Pollywog Association	Near Oakwood	2.50	Old strip mine	2.1	487
Duck Island Farm Lake	Near Banner	4.90	New gravel pit	1.5	316
Sportsmen's Lake	Near Lincoln	3.70	Old gravel pit	3.0	341
Average		3.23		1.73	446.5

*Secchi disc transparency at time of renovation.

ciated with large crappie populations and vice versa, as crappies seem to be the main competitors of bass.

Smallmouth Bass

Micropterus dolomieu Lacépède

The smallmouth bass is not suited to artificial lakes that depend on surface drainage for water supply. It was present in only 3 of the 22 lakes censused, although it had been stocked in others. One lake contained only two specimens, both of legal size. Another lake of 1.3 acres contained 21 of these fish, the largest weighing 1.25 pounds; a few small ones were collected, indicating partial spawning success. Associated with these smallmouth bass in the 1.3-acre lake were small bullheads, green sunfish and more than 8,500 blunt-nosed minnows.

The smallmouth is common in most Illinois streams and is frequently stocked in artificial lakes from this source. Almost without exception, the species of fish seined from small swift rivers are worthless for stocking lakes, either because they cannot tolerate lake conditions, or because they are of little value in angling. A few smallmouth bass, as well as several spotted bass, were taken from a strip-mine pond in Vermilion County that had been flooded by an adjacent stream.

White Crappie

Pomoxis annularis Rafinesque

The white crappie was present in 17 of the 22 lakes, and in one lake constituted 38 per cent of the total fish population. This species is well suited to artificial lakes and reproduces very successfully. In 13

of the 17 lakes the white crappies were stunted. Fourteen of the lakes contained black crappies as well as white. In all but two, the white crappies were more numerous.

In one lake where the white crappies were of good size (and amounted to 28 per cent of the weight of the population), they were associated with largemouth bass, warmouth bass and bluegills. The most pronounced stunting of white crappies occurred in shallow muddy lakes, where they were associated with large numbers of rough fish. In general, white crappies do well with other centrarchids, but must be thinned at frequent intervals to prevent stunting.

Black Crappie

Pomoxis nigro-maculatus (Le Sueur)

Although black crappies were present in 17 of the 22 lakes, they were usually less numerous than the white and of larger average size. Stunting was common, due to overpopulation and to competition with rough fish. Reproduction in the black crappie seems to be somewhat less successful than in the white. In the overfished lake mentioned in connection with the largemouth bass, the population of black crappies had been greatly reduced in number by two seasons of intensive hook-and-line fishing. In an underfished lake, a badly stunted population of black crappies made up nearly 25 per cent of the total population. Here they were associated with white crappies, bluegills, green sunfish and bullheads. In the lake containing the second largest population of black crappies, this species represented only about 6 per cent of the total weight of fish, and in other lakes it constituted only a small fraction of the total populations (4.4 per cent or less).

Bluegill

Lepomis macrochirus Rafinesque

The bluegill is the most common as well as one of the best fishes for artificial lakes. It was present in 20 of the 22 lakes censused. Associated with other centrarchids, it sometimes makes up as much as half of the population. It stands up under heavy fishing better than any other fish and produces more fish of desirable size than other sunfish. However, because it reproduces in such tremendous numbers, underfishing allows it to become stunted in many waters. In six lakes, bluegills made up from 20 to 53 per cent of the weight. Smaller percentages of bluegills were associated with large populations of rough fish, forage fish and bullheads. Stunting was common under these conditions.

Warmouth Bass

Chaenobryttus gulosus (Cuvier)

The warmouth, present in 13 of the 22 lakes, is much less desirable than the bluegill. By weight it never represented more than 11 per cent of any population and usually much less. This species shows a wide range of sizes among individuals belonging to a single brood, a peculiarity similar to that found in the largemouth bass. In most lakes, only a small number of fish were large enough to interest fishermen, while the greater number were small. The ratio was about one or two large fish to several hundred small ones. For all practical purposes the warmouth bass adds little to the fish populations of artificial lakes in Illinois.

Green Sunfish

Lepomis cyanellus Rafinesque

The green sunfish, found in 21 of the 22 lakes, is the species most frequently introduced into lakes from small streams. In lakes it multiplies very successfully, but seldom produces fish of desirable size. In four newly constructed and improperly stocked lakes, it made up from 5 to 57 per cent of the fish populations. The entire populations of many lakes did not include any green sunfish large enough for angling. The green sunfish must be considered detrimental in artificial lakes, because it competes with more desirable fish and usually does not reach an attractive size itself. This voracious fish remains close to shore and makes bank fishing for more desirable kinds difficult.

Pumpkinseed Sunfish

Lepomis gibbosus (Linnaeus)

The pumpkinseed was found in only 5 of the 22 lakes. It was never numerous and rarely of good size. Although some-

what more desirable than the green sunfish, it is much less so than the bluegill.

Orange-Spotted Sunfish

Lepomis humilis (Girard)

Although present in 9 of the 22 lakes, the orange-spotted sunfish never grows to a desirable size and should never be stocked in artificial lakes. In one recorded instance, fish of this species reached an estimated population of 15,000 per acre and crowded out other centrarchids.

Yellow Perch

Perca flavescens (Mitchill)

The yellow perch, common in artificial lakes of some western states, does poorly in Illinois. In 7 of the 22 lakes censused, it was represented by a few individuals of small size. It seems unable to spawn successfully in Illinois lakes and adds little or nothing to fishing.

Yellow Bass

Morone interrupta Gill

The yellow bass was found in 7 of the 22 lakes. In only one instance had it reproduced successfully. The yellow bass populations were made up of a few individuals large enough to interest panfish anglers. Because of its inability to reproduce successfully, and its small average size, this fish is of little value in small artificial lakes in Illinois.

Black Bullhead

Ameiurus melas melas (Rafinesque)

The black bullhead was found in 20 of the 22 lakes. It is a fish well suited to artificial lakes and of importance in lake management. Large populations of stunted fish are common and often necessitate artificial thinning in order to produce bullheads of good size. In 6 of the 20 lakes, populations of black bullheads made up from 39 to 73 per cent of the weight of fish present. Bullheads of large size were found in lakes containing small numbers of these fish. The bullhead is desirable not only because it reproduces successfully, but because it bites readily and is easily taken by inexperienced fishermen. Although it tends to keep shallow lakes and ponds roily, it will survive under unfavorable conditions longer than most other Illinois fish.

Yellow Bullhead

Ameiurus natalis natalis (Le Sueur)

The yellow bullhead, less common than the black in artificial lakes, was present in 16 of the 22 lakes censused. Populations in this species are usually much smaller than in the black. In 5 lakes it made up from 0.4 to 8.4 per cent of the total fish population; only a few were present in the other 11 lakes. Black and yellow bullheads are often found together, but in most lakes the blacks are more numerous. The yellow bullhead seems less likely to become overnumerous and stunted than the black species, but it is somewhat less desirable as a pan fish.

Speckled Bullhead

Ameiurus nebulosus marmoratus (Le Sueur)

The speckled bullhead, common in the Illinois River and connecting bottomland lakes, was taken from only 2 of the 22 artificial lakes. One of these had been recently flooded by the Illinois River, and the other had received stock from that source. This fish ordinarily does not reproduce successfully in artificial lakes, although some young were found in one instance. It grows well, but cannot be counted upon to maintain its numbers.

Carp

Cyprinus carpio Linnaeus

Carp were found in 17 of the 22 lakes, although no records could be found that any of these lakes had been stocked with this fish. In several lakes flooded occasionally by rivers, they could have entered with flood waters. Young carp are sometimes introduced through the use of live bait; and the adults swim upstream and jump the spillways into many lakes during high water. In no lake was a large carp population found with a good game-fish population. Always where carp were numerous, the hook-and-line fish were not only small in numbers, but were small in size and in poor condition. In several lakes a small number of large carp were present. This seems to indicate that young are not

produced every year, or if produced do not survive. Carp and buffalo are responsible for much of the roily condition of the water in artificial lakes, as their removal is always followed by a pronounced increase in transparency.

Redmouth Buffalo

Megastomatobus cyprinella (Valenciennes)

Eight of the 22 lakes contained redmouth buffalo, constituting from 2.5 to 73 per cent of their total populations. These and other kinds of buffalo enter lakes on flood waters. Sometimes, however, lakes containing these fish were some distance from rivers and it is impossible to say how they had entered, unless through irresponsible stocking.

Mongrel Buffalo

Ictiobus niger (Rafinesque)

Ten of the 22 lakes contained this species, although it was rarely as numerous as the redmouth. The mongrel buffalo made up from 0.4 to 12 per cent of the populations containing them.

Smallmouth Buffalo

Ictiobus bubalus (Rafinesque)

Smallmouth buffaloes were present in 6 of the 22 lakes and were usually large in size. Two fish from Upper Twin Lake averaged 25 pounds each; 24 fish averaging 12.1 pounds each made up 37 per cent of the fish population of Lower Twin Lake. This buffalo is usually less numerous than the other two, but all three often are found together. The buffaloes should be excluded from artificial lakes, as they are rarely caught on hook-and-line and, like the carp, are associated with roily water and poor populations of game and pan fish.

Gizzard Shad

Dorosoma cepedianum (Le Sueur)

Gizzard shad were present in 10 of the 22 lakes. In some cases they were introduced by floods from nearby streams. In others they were stocked as forage fish. They are not satisfactory for this purpose in artificial lakes because they reproduce in tremendous numbers and rapidly become too large to be eaten by the game fish present. In almost every case, large shad populations were associated with small numbers of bass. In 5 of the 10 lakes the shad constituted from 48 to 65 per cent of the entire fish populations (by weight), and the game and pan fish were small and stunted. This species is obviously not useful in artificial lake management.

Golden Shiner

Notemigonus crysoleucas auratus (Rafinesque)

The golden shiner, found in 17 of the 22 lakes, was probably introduced as forage for bass. In these lakes there was no correlation between good bass populations and an abundance of golden shiners. In the six lakes containing the largest numbers of shiners, only one was maintaining a good bass population. Shiners may serve as forage fish when they are small, but often become too large to be useful. They seem to serve little purpose in artificial lakes and they compete with more desirable fish for food.

Other Fish

Other fish found in small numbers in one or several of the 22 Illinois lakes censused are listed in table 3. Most of these species are relatively unimportant, either because of their lack of angling value, inability to compete with other species or inability to reproduce successfully in the artificial lake habitat. The list contains several fish of economic importance, namely the channel and flathead cats, white bass and sheepshead, which are unable to maintain their numbers. It also includes several minnows of relatively small size which reproduce successfully and are therefore suitable as forage species for bass and crappies, if furnished adequate protection.

Many of these fish were introduced into the lakes through actual flooding of these bodies of water by nearby streams in times of high water. When the water receded the stream fish were left stranded in the lakes. Others probably represent escaped bait, brought in by fishermen.

Small numbers of hybrid sunfish were present in six lakes. Most of these were

Table 3.—List of fishes of lesser importance in the 22 artificial lakes listed in table 2; showing occurrence, per cent of total fish populations by weight, number per acre, and ability to reproduce in small artificial lakes.

Kind of Fish	Scientific Name	Occurrence, Number of Lakes	Per Cent of Total Population by Weight, Range	Number per Acre in Maximum Population	Ability to Reproduce
Bowfin	*Amia calva* Linnaeus	2	4.5–tr.	4	Moderate
Quillback	*Carpiodes cyprinus* (Le Sueur)	8	5.0–tr.	23	Good
Common sucker	*Catostomus commersonii* (Lacépède)	8	tr.	8	Poor
Chub sucker	*Erimyzon sucetta kennerlii* (Girard)	4	tr.	1—	Poor
Spotted sucker	*Minytrema melanops* (Rafinesque)	5	6.5–tr.	50	Moderate
Northern redhorse	*Moxostoma aureolum* (Le Sueur)	4	tr.	1	None?
Silver redhorse	*Moxostoma anisurum* (Rafinesque)	1	tr.	1—	None?
Horned dace	*Semotilus a. atromaculatus* (Mitchill)	3	tr.	1—	None
Common shiner	*Notropis cornutus* (Rafinesque)	2	tr.	1—	None
Bullhead minnow	*Ceratichthys perspicuus* (Girard)	2	tr.	52+	Moderate?
Blunt-nosed minnow	*Hyborhynchus notatus* (Rafinesque)	4	12.2–tr.	6,674	Excellent
Channel cat	*Ictalurus lacustris punctatus* (Walbaum)	6	7.0–tr.	26	None
Flathead cat	*Pilodictis olivaris* (Rafinesque)	1	tr.	1—	None
Tadpole cat	*Schilbeodes gyrinus* (Mitchill)	4	tr.	80	Moderate
Grass pike	*Esox vermiculatus* Le Sueur	3	tr.	5	None?
Top minnow	*Fundulus notatus* (Rafinesque)	4	tr.	7	Good
White bass	*Lepibema chrysops* (Rafinesque)	1	tr.	1—	None
Log perch	*Percina caprodes* (Rafinesque)	2	tr.	1—	None
Johnny darter	*Boleosoma n. nigrum* (Rafinesque)	1	tr.	1—	None?
Long-eared sunfish	*Lepomis megalotis peltastes* Cope	2	tr.	20	Moderate
Hybrid sunfish	*Lepomis macrochirus* x *L. cyanellus* and others	6	tr.	15	None
Brook silverside	*Labidesthes sicculus sicculus* (Cope)	3	tr.	18	Moderate
Sheepshead	*Aplodinotus grunniens* Rafinesque	4	3.4–tr.	57	?

tr. = trace.

bluegill x green sunfish, and bluegill x pumpkinseed sunfish with smaller numbers of bluegill x warmouth bass. In one lake some of the hybrids were larger than the largest parent types.

Cropping

A satisfactory yield of hook-and-line fish may be taken from an artificial lake when adequate numbers of fast-growing fish are present. Swingle & Smith (1939, 1941, 1942) and others have indicated that the carrying capacity of a lake depends upon its fertility, and that the use of fertilizers will increase the number of pounds of fish a lake will support. However, the application of fertilizers to lakes is expensive and in Illinois may be impractical or unnecessary. There is little object in adding fertilizers to a lake unless the surrounding soil is very poor, or the fishing intensity demands a heavy fish production. Fertilizers added to an uncropped lake are wasted. Artificial ponds on rich land cannot be fertilized without indirectly endangering the survival of fish, as fertilizers reduce the amount of dissolved oxygen in the water. Swingle & Smith (1941, p. 221), working on artificial lakes in Alabama, state that high fish production cannot be maintained over a period of years without fertilization. In Illinois, however, high production has been maintained in some artificial lakes for many years without the use of fertilizers.

Several farm ponds recently built by the U. S. Soil Conservation Service in Illinois have been located below barn lots so that these lots may act as sources of fertilizer. Lakes thus located are usually on eroded soil. They are benefited by the inwash of animal waste, provided precautions outlined by the Service are followed; that is,

by-passing of barnyard drainage, so that it cannot flush directly into the pond, and adequate planting and protection of steep hillsides adjacent to the ponds, fig. 1. In two instances, however, adequate by-passes were not built, and hillsides were not properly protected by the lake owners; as a consequence, fish were unable to survive in the lakes, fig. 2.

Fig. 1.—A farm pond in Adams County, Ill., built by the U. S. Soil Conservation Service. Although located below a barn lot, this pond is protected from yard drainage by a levee. No loss of fish from pollution has ever occurred here.

The observations of Swingle & Smith (1939) in Alabama ponds, and the fish yields for several years from Fork Lake (see section following), indicate that a lake once stocked with fish approaches its maximum carrying capacity within a single year. However, lakes in regions with a short growing season, and large reservoirs stocked with small numbers of fish, may require two seasons.

The carrying capacity of an individual lake may vary with the kinds of fish introduced; a lake reaches its maximum capacity when the most efficient use is made of its food resources.

As a fish population multiplies and its total weight approaches the maximum carrying capacity, the growth rate of the fishes gradually decreases until actual stunting begins. Unless measures are taken to reduce the population, conditions unfavorable to growth will continue, and the lake will produce few fish of desirable sizes. A rapid growth rate must be maintained in order to produce fish of large size before they live out their life span. Therefore, it is obvious that the population level should be held at a figure below the maximum carrying capacity of the lake. In natural waters, especially in those away from human habitation, a continuous reduction of the fish population may come about through predators. These predators are largely absent in artificial waters.

From age analyses of the complete fish populations of several lakes, it has been found that the broods of fish of the several kinds present vary in numbers from year to year. Creel census records over a period of years likewise show fluctuations in the abundance of the various kinds of fish caught. These fluctuations in brood sizes are related not only to the success of spawning but, more especially, to the survival of young fish during their first season. Fluctuations in the numbers of young fish surviving after their first season are a source of trouble to the fish manager. If large broods escape severe losses during the early months of life, their members may grow rapidly until their food requirements begin to tax the food resources of the lake. Then they grow very slowly or become stunted. On the other hand, very small broods may have little food competition and make rapid growth to desirable size, but they may not be numerous enough to bear the fishing load when their members should make up the bulk of the hook-

and-line catch. Abnormally large or small broods tend, therefore, to make fishing uncertain. A successful method of cropping must be adjusted to cover these variations.

The average length of life of important pond fishes is variable but, in Illinois, 6 years is near the maximum for most species. Hansen (ms. unpublished), working on the fish of Lake Decatur, reports that dominant broods of crappies and gizzard shad practically disappear in 4 years. Largemouth bass sometimes reach the age of more than 10 years, but few attain this age in the warm waters of artificial lakes. Cropping for high yields, year after year, involves a consideration of the number of broods making up a population. Theoretically these broods (for convenience we will use six) can be arranged to form a pyramid of numbers, such as is illustrated in fig. 3. The brood of the year, forming the base of the pyramid, is the largest. The smallest and oldest brood forms the apex of the pyramid.

It has been estimated by Dr. Thompson, in his work on the bottomland lakes of the Illinois River, and by Dr. D. F. Hansen, Assistant Zoologist of the Illinois Natural History Survey, in his study of Lake Decatur, that the normal or accidental death rate (exclusive of angling) of fishes reduces the numbers of any given brood during the earlier years about one-half within a year's time. If this is true, and if spawning is equally successful in all years, at any given time the number of individuals belonging to a selected brood is twice that of the brood spawned in the preceding year, and one-half as numerous as the one of the following year. As the natural death rate of fish 6 or more years old is very high, cropping should remove all of these older fish, and a fraction of each of the other broods, amounting to at least one-fourth of their total numbers. Some means should be devised for removing a portion of the fingerlings less than a year old and yearlings still too small to be of value for food or angling, fig. 3.

As the crop is being taken, the fish re-

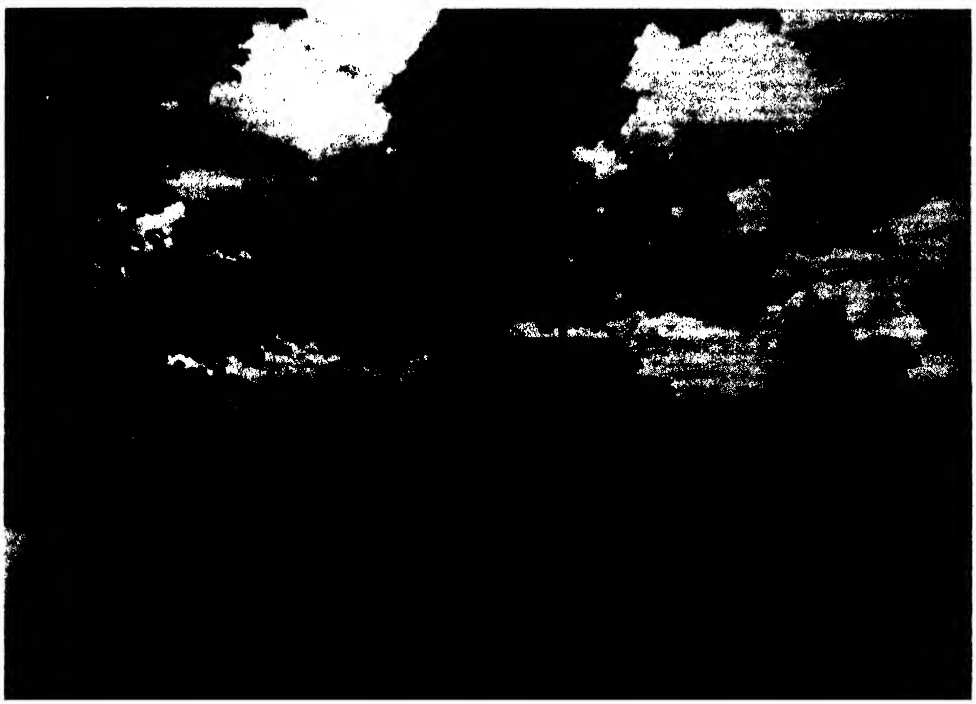


Fig. 2.—A farm pond built by the U. S. Soil Conservation Service in Schuyler County, Ill. Measures outlined by the S. C. S. for by-passing barnyard sewage around the lake were not followed and the first fish stocked died from lack of dissolved oxygen. Later, fencing and planting of the slopes and by-passing most of the runoff from the barn lot so improved water conditions that fish could live.

maining in the lake are growing rapidly and gradually moving up in their relative positions in the pyramid of numbers. The effect of controlled cropping is to hold the total weight of fish present at a level somewhat lower than the maximum carrying capacity of the lake. This cropping insures an abundance of food at all times, which in turn supplies the nourishment necessary for rapid growth. Meanwhile, the population, composed of individuals covering a wide range of sizes, is making efficient use of the food resources. The food resources of a lake are utilized most efficiently when the largest possible percentage goes to produce new flesh and the smallest percentage to maintain metabolism in the fish population. If the lake is overpopulated it is conceivable that all food will be used to maintain metabolism. If it is underpopulated the fish may grow very rapidly but use only a small portion of the available food. Somewhere between these extremes is an optimum population in which the greatest amount of new flesh may be produced from the food resources of an area unit of water.

Several experiments now in progress indicate that this type of cropping reduces the numbers in all broods so that no single brood of any species may dominate the lake. From the standpoint of the angler, the fish grow rapidly, reach large sizes and are numerous enough to maintain good fishing.

The illegality of taking small fish in many states makes the application of this cropping plan difficult. Technicians should make arrangements within their states to demonstrate the effects of this method.

Equal cropping of all broods in a lake assumes that all kinds of fish present are of equal value in fishing. Frequently this is not the case. Often fishermen are aware that a more valuable species is being replaced by one of less value, but are at a loss as to what should be done. In these cases special effort must be made to crop the less desirable species much more heavily than the others, especially among the younger broods.

In the artificial lakes of Illinois, underfishing is a serious problem. As may be seen in fig. 3, underfishing takes a very small slice from the top of the pyramid of numbers. In a lake that has been underfished for several seasons, only the oldest fish are of desirable size. In a lake that is

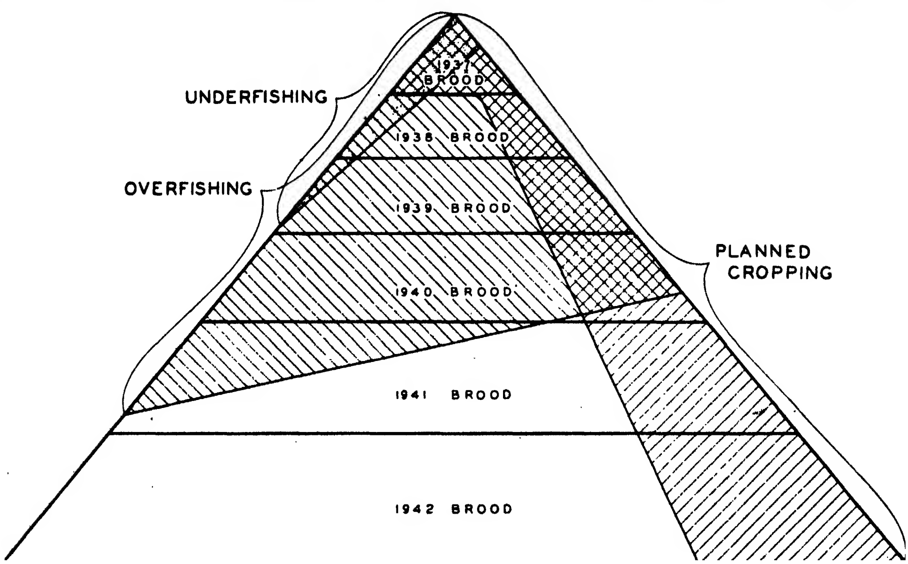


Fig. 3.—Pyramid of numbers representing a theoretical population of fishes in an artificial lake. The population is divided into six annual broods (including all species). Successively smaller sections of the diagram from the base to the apex indicate reduction in the numbers of fish in each brood from natural or accidental causes (exclusive of angling). In an underfished population, anglers remove only a small slice of the pyramid, composed of a fraction of the older broods. Overfishing removes nearly all of the older and larger fish, leaving principally young fish too small to be taken. A theoretical plan of cropping proposes the removal of all of the oldest brood, and a fraction of the other broods equal to approximately one-fourth of each.

underfished, the total poundage of fish remains at or near the maximum carrying capacity of the lake. The fish are living on a subsistence basis and grow very slowly, if they grow at all. Frequently fish that are long enough to interest anglers are so emaciated that they are not kept when caught. Commonly, fish in these crowded lakes are about the same size as fish one-half their age in properly cropped waters.

Fig. 4.—Onized Lake on the recreation grounds of the Owens-Illinois Glass Company near Alton, Ill. This lake, which produced a hook-and-line yield of nearly 350 pounds of fish per acre in 1939, represents the only overfished lake ever observed by the Illinois Natural History Survey.

Although we have records of a number of lakes that have produced high fish yields, in only one instance do we have a complete story of overfishing. In this case, Onized Lake, fig. 4, the body of water was relatively small and the fishing intensity very heavy. During the 1939 fishing season the hook-and-line yield was almost 350 pounds per acre. The yield study covered a period of two seasons and part of a third. The yield was very high during the first season, but lower and lower during the next two seasons. In the middle of the third summer, the remaining fish were censused by poisoning the lake. A comparison of this census with the theoretical pyramid of numbers indicates that overfishing removes the top from the pyramid, fig. 3. The census included a large number of fish, nearly all belonging to the three youngest age groups. Overfishing decreased the catch per man-hour as well as the average size of the fish caught, until few fish of desirable size were taken. The effect of overfishing on the growth rate of the population remaining at the time of poisoning is being determined by scale studies. Apparently the young fish that had escaped the anglers were growing exceptionally fast. These young fish were very numerous, suggesting that, as the population thinned, the survival of spawn increased. None of the species present when intensive fishing was begun had been eliminated. Closing the lake to fishing for one season would have allowed many of these young fish to attain

desirable size, and all evidence of overfishing would have disappeared.

In comparing the average size of the fish caught and the catch per man-hour from this lake, while it was overfished, with catches from several underfished waters, a striking similarity was found. In both, the catch per man-hour was low. In both, a very large per cent of the fish caught were small. It is little wonder that the average fisherman confuses underfishing with overfishing. The relation between size and age in fishes is the best criterion for judging the status of a population. For example, scales from 6-inch bluegills taken from an overfished lake show that the fish were less than 2 years old. Scales from bluegills of the same size taken from underfished lakes typically show from four to six annual rings. Laymen can often distinguish between fish from an overpopulated lake and an underpopulated lake by the fact that those from the former are usually thin bodied, have large heads and unusually prominent eyes.

Experimental Combinations of Fish

The meagerness of hook-and-line fishing furnished by many unmanaged artificial lakes leaves little doubt as to the necessity of proper management for the production and maintenance of good fish yields. The more common causes for poor yields are summarized as follows:

1. Indiscriminate stocking—the introduction of fish physiologically unsuited to the artificial lake habitat or those of little or no angling value.
2. Undesirable populations — those in which rough fish or other species not useful in fishing make up a large part of the populations and compete with the hook-and-line species.
3. Overpopulation — as in lakes containing only desirable fish but so densely populated that stunting results, which in turn means poor fishing.

All of these causes may be controlled in small artificial lakes, or in large lakes that can be drained.

Lakes controlled by fishing clubs sometimes produce good sustained yields of fish but, although the yearly crop and the catch per man-hour remain at satisfactory levels, there are great fluctuations in the abundance of the various species from year to year. To fishermen who have preferences in fishing, these fluctuations are perhaps an annoyance. The study made by Thompson (ms. unpublished) of the catch records of Rinaker Lake near Carlinville illustrates the extent of these variations. In Rinaker Lake, where complete catch records are available from 1932 to date, the important species are largemouth bass, white crappies, bluegills and bullheads. The catch of bluegills remained most nearly constant throughout this period of years, at 1.25 to 2.25 pounds per fisherman-day. Good catches of bass were made from 1932 through 1936, and the crappie catch was poor for these years. In 1937 the catch of crappies reached an all-time high of 2.5 pounds per fisherman-day, and the catch of bass was very low (less than 0.25 pound per fisherman-day). Since 1937 the bass catch has been steadily improving and that of crappies decreasing. Bullheads have remained at a low population level throughout all years, but individuals caught are of exceptionally large size. The total hook-and-line yield for this lake has averaged about 4 pounds per fisherman-day and 100 pounds per acre per year during this period.

A more or less constant yield of bluegills, with large fluctuations in catches of crappies, bass and bullheads, seems to be typical of lakes containing these species. Usually, however, when crappies or bullheads reach their peak of abundance they are not taken in sufficient numbers to prevent stunting and to give bass an opportunity to make a "comeback." Fluctuations of this kind make fishing for selected species uncertain. In lakes such as Rinaker, the fish manager should attempt to control the size of broods of young fish produced each year, with the object of maintaining a more nearly uniform proportion among the different species.

The great seasonal variation in the success of fishing for a selected species in lakes containing many kinds of fish has led to experimentation with single species and simple combinations of more important fish. In the stocking of many new ponds and several large reservoirs in Illinois, an attempt is being made to discover some means of maintaining good bass fishing. The combination of largemouth bass and bluegills has the following points in its favor:

1. Both species are well suited to the artificial lake habitat and are much sought by anglers. The largemouth bass is Illinois' most important large game fish, and the bluegill is a favorite pan fish with fly fishermen.

2. The bluegill is very prolific and spawns throughout the summer. Enough young are produced to maintain an adequate population for angling, as well as to furnish forage for bass.

3. There is little food competition between these two species. Bass feed upon young bluegills, crayfish, adult aquatic and terrestrial insects and the nymphs of dragonflies and damselflies; bluegills on entomostraca, midge larvae and aquatic vegetation (particularly algae).

4. The use of these fish allows lakes to remain clear, thereby increasing their recreational and aesthetic value.

A yield study of the bass-bluegill combination was made at Fork Lake, near Mount Zion, Ill. The area of this pond during the past 4 years has varied between 1.00 and 1.38 acres; the maximum depth from 7 to 9 feet, depending on the water level. Two publications give in detail the results of investigations in 1938 and 1939 (Thompson & Bennett 1939; Bennett, Thompson & Parr 1940). In 1938 the lake was poisoned because it contained many undesirable fish, and restocked with 270 stunted adult bluegills and 1,440 largemouth bass fry. No more fish have been placed in the lake since this restocking in 1938. Intensive cropping was begun in 1939, use being made of both hoopnets and hook-and-line fishing. Six 1-inch-mesh hoopnets were fished for 1 week each month from March to November, inclusive, during 1939, 1940, 1941 and part of 1942, and all fish caught were removed from the lake. Hook-and-line fishing was more effective than hoopnets in removing largemouth bass. The total yields for these years are shown in table 4.

Table 4.—Fish yields from Fork Lake, near Mount Zion, Ill., 1939, 1940, 1941 and 1942.*

Year	Bluegills			Largemouth Bass		
	Number	Total Weight, Pounds	Average Weight, Pounds	Number	Total Weight, Pounds	Average Weight, Pounds
1939	940	172.4	0.183	349	51.0	0.146
1940	778	146.2	0.188	217	52.9	0.224
1941	503	71.8	0.145	185	57.3	0.309
1942*	253	37.5	0.148	40	22.7	0.568
Total	2,474	427.9		791	183.9	

Combined yield—3,265 fish, weighing 611.8 pounds.

* Cropped from March through June, 1942.

As the lake was cropped, no attempt was made to protect either bass or bluegills during the spawning season, and the lower size limit of the fish taken was controlled ordinarily by the mesh of the nets used. On some net raises, however, very small fish were trapped when the meshes became bunched. A small number of bluegills less than 2 inches long were caught in this manner. In 1941, the yield of bluegills was smaller than in previous years, although the bass yield was somewhat larger. This small yield of bluegills in 1941 was due in part to the poor survival of bluegill fry until late summer in 1939. During most of the bluegill spawning season in 1939, young bass 5 to 7 inches long fed upon bluegill fry before they left the nests. A field observation on this point was verified by stomach analyses of many bass.

Further analyses of the fish yields for these years show that 39.2 per cent of the bluegills taken in 1939 were of desirable size or larger (6 or more inches); 60.6 per cent in 1940 and 38.4 per cent in 1941. Legal bass (10 inches or larger) made up 0.85 per cent of the catch in 1939; 8.8 per cent in 1940 and 29.5 per cent in 1941.

The largest bluegill taken weighed 0.74 pound, and half-pound bluegills were fair-

ly numerous. The growth of bass was about average for most Illinois waters, fig. 5.

The hook-and-line catch in Fork Lake was 2.84 fish per man-hour in 1939; 3.23 fish per man-hour in 1940 and 2.98 in 1941. This catch was made up almost exclusively of bass, as artificial baits having hooks too large for bluegills were commonly used. The figures on catch per man-hour are based on both illegal and legal bass, as all were kept. The maximum catch was made in April, 1940, when 27 small bass were taken in 2 man-hours of fishing.

Previous to the removal of rough fish and bullheads in 1938, Fork Lake was very muddy and devoid of aquatic vegetation. When these fish were removed and replaced by bass and bluegills, the water cleared and remained clear, and after a few weeks the water weed, *Potamogeton foliosus* Rafinesque, appeared. This weed spread during 1939, 1940 and 1941, until it formed dense mats in all shallow water up to 5 feet in depth. These dense tangles of coarse vegetation offered excellent protection for young bluegills, but very little food. During the summer of 1941 when this vegetation was most abundant, small bluegills and bass of all sizes grew slowly because large numbers of young bluegills swarmed in the plant mats, but found little nourishment, and the bass were unable to use them for food. However, in August the weed practically disappeared within a few weeks and almost concurrently the bass became very fat, probably through assimilation of the overabundant small bluegills.

Higher aquatic plants are a detriment to small artificial lakes in that they promote the survival of too many young fish, fig. 6, and during their growing season they take up nutrient materials and light that would otherwise produce algae, the basic food of the aquatic environment.

On July 8, 1942, the Fork Lake experiment was suddenly terminated by abnormal precipitation. On this date, a rain of approximately 4 inches caused the dam to break near the center, and a part of the

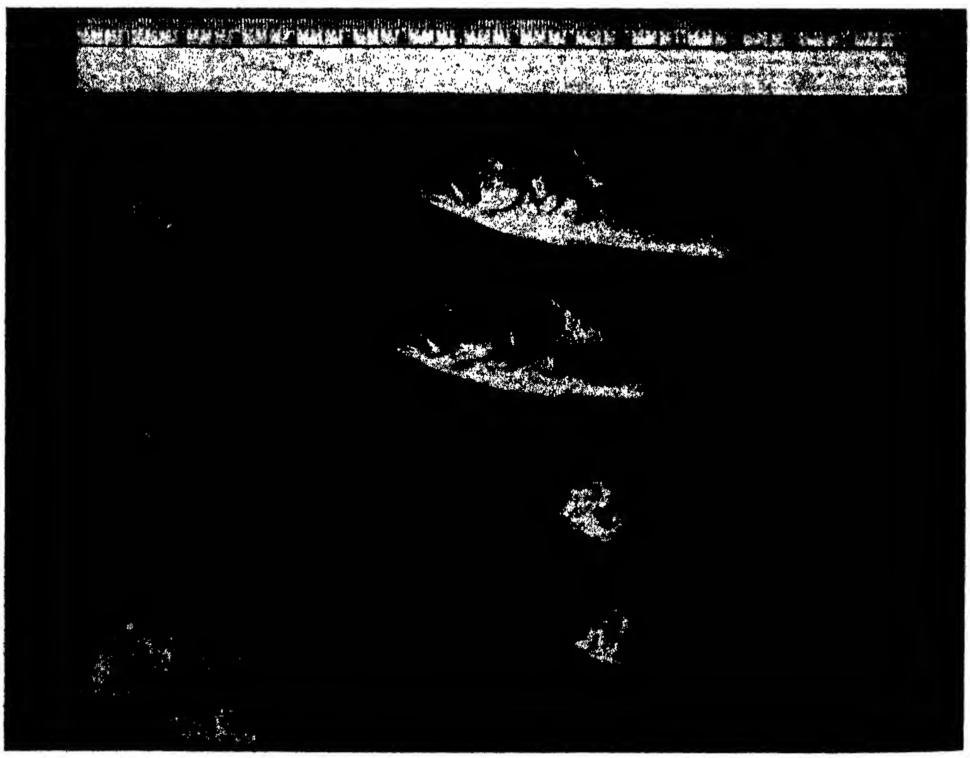


Fig. 5.—Largemouth bass and bluegills from Fork Lake, near Mount Zion, Ill., April, 1941, showing 1938 brood bass and 1938, 1939 and 1940 brood bluegills.

fish population was washed across a cornfield and into a small creek below. By chance Mr. Gernon P. Hesselschwerdt and the author arrived at the lake when about two-thirds of the water had passed out of the basin. The larger fish remaining in the lake at that time were captured by placing a section of hoopnet lead across the break. As it was impossible to estimate the numbers of bass and bluegills that had been washed out of the lake, particular attention was directed to the remnants of the original stock of fish. Thirty-four of the original bass, averaging 1.76 pounds each, were caught in the net and 32 were left stranded in the lake basin. Apparently the initial rush of water through the broken levee was considerable, as corn stalks were flattened over a wide area in the field below the lake. Any fish near the point of break must have been washed out shortly after the dam gave way. It therefore does not seem unreasonable to assume that nearly 100 of the original bass may have been present. The bass population, including the original stock, 1940, 1941 and 1942 broods, probably numbered several thousand. The total weight of those observed was estimated at about 200 pounds. These bass had become so "educated" that few of them would enter hoopnets or bite on artificial baits.

About 30 large bluegills, belonging to the 1938 brood (4 years old; weight between 0.50 and 0.75 pound each) were taken, but most of the bluegills caught in the net were 1939 and 1940 brood fish and averaged 6 inches long. Thousands of young bluegills of the 1942 brood were left stranded in beds of *Potamogeton foliosus*. None of the original bluegills were taken.

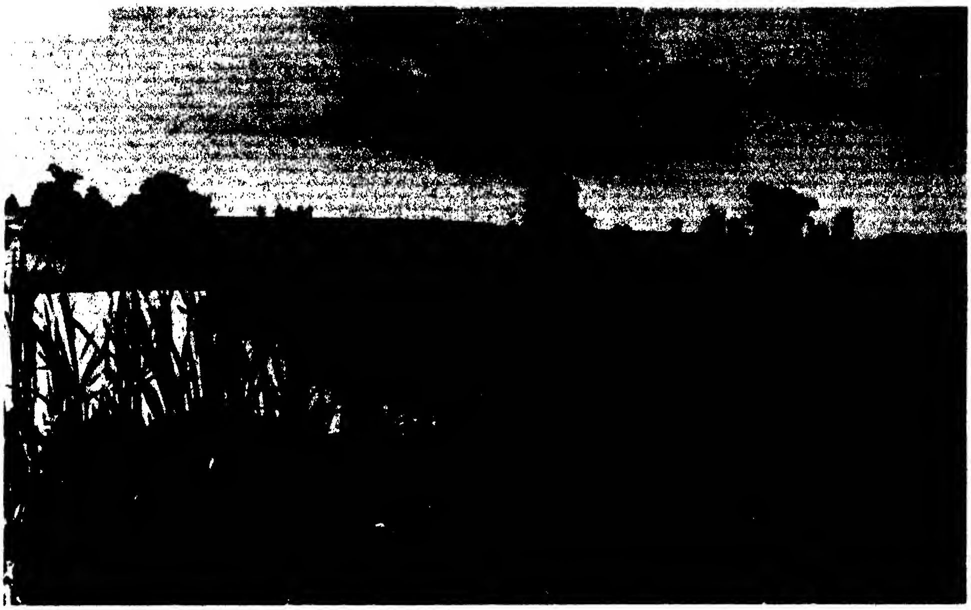


Fig. 6.—Aquatic vegetation planted by the U. S. Soil Conservation Service around a farm pond in Adams County, Ill. This type of vegetation, while useful in controlling soil erosion, promotes the survival of too many young fish and often becomes so dense that bank fishing is nearly impossible.

Fish technicians and sportsmen have long been interested in returns from fish stocked in various waters, but little concrete information is available, except from trout stream investigations.

The recognition of the original stock of bass and bluegills recaptured from Fork Lake was possible because scale samples were taken from all fish. Moreover, as the adult bluegills were 2 or more years old when placed in the lake, they were easily separated from the younger fish. Largemouth bass were stocked as fry in 1938, and no young were spawned until 1940. Thus no difficulty was encountered in distinguishing them from the 1940 and

1941 broods of bass. Table 5 gives the numbers of these fish recaptured in four fishing seasons since the bass and bluegills were placed in Fork Lake.

These returns must be considered nearly "optimum" because the lake contained no other fish when the bass and bluegills were introduced, and food competition was kept at a minimum by constant cropping. The original bluegills could have suffered no predation from the bass as they were always too large to be taken. Smaller returns from the bass are undoubtedly the result of cannibalism during 1938 and 1939.

Fourteen other lakes have been stocked with bass and bluegills and followed as carefully as time would allow. The information from Fork Lake, and other lakes containing bass and bluegills, suggests the following points of interest in regard to the use of this combination:

1. There is a marked improvement in fishing, especially for bass, over that furnished by mixed populations of several species of fish.

2. Under moderate fishing intensity, largemouth bass are unable to control the numbers of bluegills. Therefore, in stocking a new or renovated lake, it is unnecessary and possibly undesirable to stock more breeder bluegills than breeder bass.

3. As bass spawn at the age of 2 years and bluegills at 1 year, it is better to stock both adult bass and adult bluegills, rather than adult bluegills and bass fry or fingerlings less than a year old.

4. A large crayfish population was in evidence in several lakes where bass growth was exceptionally rapid. In lakes poor in crayfish, the bass-bluegill combination might be improved by introducing crustaceans of species locally abundant.

5. Bass and bluegills will maintain their numbers under intensive fishing. It is estimated that Fork Lake was cropped to the extent of about one-half of its carrying capacity for these species during the 4 years covered by the study.

6. In some lakes where the fishing pressure is light, it may be necessary to destroy bluegill nests, or remove substantial numbers of bluegill fry, in order to maintain a rapid growth of this species.

Table 5.—Returns from the original planting of 270 adult bluegills and 1,440 largemouth bass fry in Fork Lake, June, 1938.

Year	Bluegills		Largemouth Bass	
	Number	Per Cent of Original Stock	Number	Per Cent of Original Stock
1939	162	60.0	349	24.2
1940	27	10.0	217	15.1
1941	2	0.7	74	5.1
1942	0	0.0	66*	4.6*
Total	191	70.7	706	49.0

* Collections from March through June plus fish salvaged from washout.

In lakes where bass fishing is of primary interest, attention is being directed toward the use of largemouth bass alone. Ridge Lake, an experimental body of water of about 18 acres, near Charleston, Ill., has been reserved as a study area for this species. Although the bass investigation is less than 2 years old, its progress may be of some interest. The lake, built in the valley of an intermittent stream, began to fill after April 17, 1941. During May, 100 breeder bass were stocked in about 6 acres of water that had collected behind the dam. These fish spawned in early June, and 38 broods of approximately 2,000 fish each, or 76,000 fry, were counted. In July, 336 yearling bass (5 to 7 inches long) were added to reduce the number of young produced in the lake. All fish stocked, both as breeders and yearlings, were fin clipped for later identification.

The growth of the 1941 brood fish produced in the lake has been extremely rapid. Collections made in October, when these fish were 4½ months old, included

individuals as large as 10.5 inches, and many were from 8.5 to 10.0 inches. The smallest fish taken was 4.5 inches long. A few of the planted yearling bass were caught and identified by their clipped dorsal fin. These had grown from less than 7 inches at the time of their introduction, to between 11.5 and 12.5 inches by October.

Two other experimental lakes, one containing bass and one bass and *Gambusia affinis* (Baird & Girard), are being studied. Neither has been followed long enough to give much pertinent information. However, several inferences based on studies of bass populations in other lakes seem to favor the use of this fish alone or in combination with some minnow of small size:

1. Stunting (4 or 5 years to reach legal length) in bass is apparently rare in Illinois artificial lakes, as no stunted populations, such as frequently occur in small glacial lakes, have been observed. This difference is probably due to a greater variety and abundance of foods, other than fish, that are available.

2. A lake containing only bass should maintain a larger population of these fish than was found in most lakes inhabited by mixed populations. In the lake census work the largest bass population found averaged 58 pounds per acre and this represented only 14.8 per cent of the total fish population (see tables 1 and 2).

3. A single brood of bass may show a great deal of variation in the size of individual fish shortly after the brood becomes scattered. The fact that smaller individuals are eaten by the larger fish of the same brood partially eliminates the danger of dominant slow-growing broods of bass.

4. Although bass fry and fingerlings

Fig. 7.—Bluegills from a new farm pond built by the U. S. Soil Conservation Service in Adams County, Ill. These fish averaged 0.10 pound when stocked in June of 1939 and 0.72 pound when recaptured, July, 1940. By 1941 this bluegill population had become badly stunted, because of overpopulation resulting from natural spawn. No more large bluegills such as these will be produced in this pond until the population is properly thinned.

are probably not so efficient as some other small fish in utilizing the food resources of a lake, their nutritive value as forage for larger bass is certainly equal to that available from so-called forage species.

5. The use of a single large species like the bass relieves the feeding pressure on the small aquatic animals and may allow the development of stocks of larger predatory invertebrates which furnish food for bass.

6. Reasonable cropping of adults should insure the survival of enough young to maintain a well-balanced population from the standpoint of the theoretical pyramid of numbers.

7. An abundance of crayfish may play a significant role where bass are used alone, as they form an important source of food and thereby increase the survival of young bass.

Other combinations of fishes are being tested in 10 new farm ponds built by the U. S. Soil Conservation Service. These are as follows:

1. White crappies and bluegills.
2. Black crappies and bluegills.
3. White and black crappies and bluegills.
4. Black bullheads and bluegills.

In these lakes, now followed for 3 years, the original stock grew very rapidly, fig. 7, and produced large broods of young during the first year. Young fish were stunted during the second and third years because their food requirements became greater than the lakes could supply. Unless efficient methods of limiting the spawn are intensively applied, the combinations listed above will invariably result in large stunted populations of small fish, valueless to hook-and-line fishermen.

Summary

1. The chief causes for poor hook-and-line fishing in Illinois artificial lakes are past improper stocking, large populations of rough fish, or other species of little value in angling, and stunting as a result of overpopulation.

2. Fishes well suited to Illinois artificial lakes are largemouth bass, white and black crappies, bluegills and black and yellow bullheads. Other fish are apparently of little value in hook-and-line fishing.

3. Lakes should be cropped in order to produce and maintain good yields. A cropping plan should include measures to control the numbers of fish of small size as well as the total poundage of large fish taken by anglers.

4. Simple combinations of fishes are being tested to determine their value in angling. The bass-bluegill combination appears to be one of the most satisfactory. Information on the use of largemouth bass alone is as yet inconclusive. Combinations of crappies and bluegills or bluegills and bullheads result in stunted populations. Unmanaged but heavily fished waters containing bass, crappies, bluegills and bullheads show marked fluctuations in numbers of bass, crappies and bullheads.

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The Prairie Chicken
in Illinois

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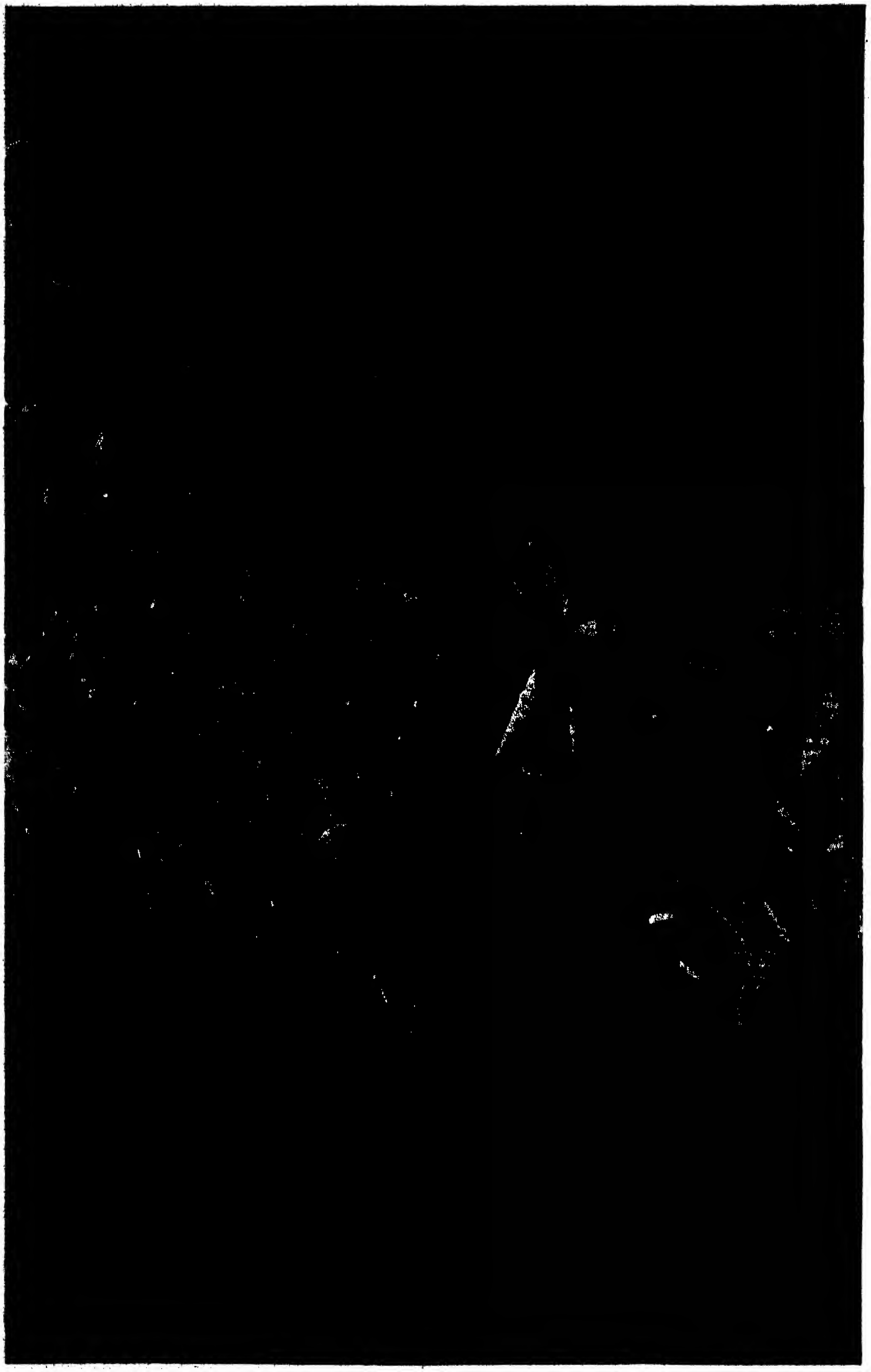

Female prairie chicken entering her nest, situated in a clump of grasses and dewberries.

The Prairie Chicken
in Illinois

RALPH E. YEATTER

THE greater prairie chicken, *Tympanuchus cupido americanus* (Reichenbach), was formerly widely distributed over the grasslands of central North America. Because of its striking appearance, its characteristic breeding behavior, and its sporting qualities, it was well known to early generations of American naturalists and sportsmen. In spite of virtual extermination over much of its original range during the past three-quarters of a century, this bird has persisted in fair numbers in a few favored prairie areas, and it has also extended its range hundreds of miles northward into cutover woodlands and farming sections in a number of northern states and Canada.

The occurrence of widely distributed local areas in which prairie chickens are maintaining themselves with some success has made possible a number of investigations by game ecologists, chiefly in the Mississippi valley, to discover basic requirements of this game bird and to outline measures to conserve and increase its numbers. Most of these investigations are still in progress.

The present report summarizes a study of the biology and management of the greater prairie chicken in Illinois, a study begun in 1935 by members of the Section of Game Research and Management of the Illinois Natural History Survey. The summers of 1935 and 1936 were spent in full-time field work in southeastern Illinois. Since that time, supplemental studies of prairie chicken habits, requirements and distribution have been continued in various parts of the state. Annually since 1935, spring and fall censuses have been made on 4 square miles of prairie chicken range in Jasper County used as a study area. Preliminary parasite and disease studies conducted by Leigh (1940) were published in another volume of the Survey *Bulletin*. The present report includes data on early distribution, present range, life history, populations, mortality causes, food habits and management of the prairie chicken in Illinois.

The writer of this report is indebted to Dr. W. Henry Leigh, formerly Assistant Zoologist of the Illinois Natural History Survey, and to Mr. R. E. Hesselschwerdt, formerly Junior Biologist of the Survey employed on Federal Aid in Wildlife Restoration Act projects carried on in cooperation with the Illinois State Department of Conservation and the U. S. Fish and Wildlife Service; both gave invaluable assistance in the field studies in southeastern Illinois. Mr. Harry G. Anderson, formerly Junior Biologist of the Survey, like Mr. Hesselschwerdt employed on Federal Aid projects, kindly analyzed the food material found in prairie chicken stomachs. The cooperation of other members of the Survey staff, especially Dr. David H. Thompson, Mr. Arthur S. Hawkins, Dr. Carl O. Mohr, Dr. Herbert H. Ross, Dr. Leo R. Tehon and Dr. Lee E. Yeager, in various phases of this study is also acknowledged. The Illinois State Department of Conservation, through many of its game wardens, assisted materially in preparing the map, fig. 1, showing the distribution of prairie chickens in the state. The writer wishes to thank the farmers in the vicinity of Hunt, Ill., who have allowed him to use their farms for field studies and census work.

EARLY DISTRIBUTION

Nearly 60 per cent of the state of Illinois was originally grassland. However, the first agricultural settlers arriving early in the nineteenth century avoided the

grassland areas and settled in the timberlands along the rivers and streams. Treeless areas were then believed to be unsuited to agriculture and, although it was necessary to clear the land along the water courses, the soil there was better drained than was that of the prairies. Moreover, along the forest margins, game was abundant, and timber and fuel supplies were close at hand. In time, the high productivity of the grassland soil became apparent, and agriculture moved to the prairie.

As the Illinois timberlands were cleared and put under the plow, prairie chickens extended their range into these areas from the adjacent prairies, in which the first settlers had found them. Later, as the prairie sod was broken and grain became common, chicken populations increased enormously throughout the grasslands. The highest populations, resulting from the early development of agriculture, seem to have occurred during the 1860's.

Favorable conditions created by interspersion of crop land and unbroken prairie were reversed, however, as Illinois agriculture developed from the primitive stage, much of it into highly intensive grain farming. The prairie chicken then began to decline over large areas of its range.

Leopold (1931) says of this period: "The prairies of Illinois, however, which Hatch describes as poor in 1836, and where Bogardus describes chickens as only 'rather numerous' in 1857, had in 1874 just passed their prime as chicken country."

The period of 1850 to 1880 was one of rapid agricultural development in Illinois. By 1880, the acreages of all farm land and of improved land in farms were reported greater than at present. Much of the improved farm land, however, did not become fully productive until later, when it was artificially drained (Case & Myers 1934). Merritt (1904) states that game declined markedly in northwestern Illinois during the upturn of agriculture immediately following the Civil War. Probably a similar trend held true for much of the state. Undoubtedly heavy hunting pressure then and later hastened the decline of prairie chickens, but a widespread decrease was inevitable under the practice of intensive grain farming and grazing that was developing in the dark soil prairie counties. The heyday of the nonresident sportsman and market hunter seems to have ended during this period.

Over half a century ago, we find the *American Field* (Aug. 27, 1881) advising its readers that prairie chicken shooting was no longer good in Illinois or Missouri. Central Illinois was said to have few birds. For good shooting, it was necessary to go "west of the center of Iowa and Minnesota."

In spite of the decline of prairie chickens, there were still, in the early '80's, occasional records in the hunting journals of fairly large kills in the east central counties of the state. However, on June 9, 1887, the Illinois State Legislature passed game laws that included a provision for a closed season on prairie chickens and ruffed grouse during 1887 and 1888, indicating increasing concern over the welfare of these birds.

At the beginning of the present century, prairie chickens were still rather generally distributed on the Illinois prairie, but were to be found only locally and in greatly reduced numbers in the dark soil counties. Under intensive agriculture and drainage, the remaining habitats were being broken into smaller and smaller units, leaving colonies in only the most favorable localities. In 1903, the season on prairie chickens, then of 30 days, was closed abruptly, and hunting was not again legalized until 1911. Following this action, shortened seasons of 5 to 15 days, with a daily bag limit of three birds, were tried until 1933. Nevertheless, chicken populations continued to decline. In 1933 the season on prairie chickens was closed and has not since been reopened.

About 30 years ago, Forbes (1912) reported, on the basis of information received from game wardens, that prairie chickens were present in at least 74 Illinois counties (nearly twice as many as in 1942). Reports received by Forbes in 1912, and now in the Illinois Natural History Survey files, indicate that prairie chickens were then holding their own or increasing in some of the less adequately drained areas in eastern Illinois, but becoming rare in the central part of the state.

Leopold's (1931) game survey of the north central states disclosed no colonies in the dark soil upland prairie counties

west of the Illinois River, although several local colonies were still present in the east central, the northern and the southeastern counties. In these southeastern counties is the main Illinois range of the prairie chicken today.

The period 1930 to 1935 saw the disappearance of nearly all of the remaining colonies in the east central counties, and a reduction of birds in the northeastern marshlands. One of the last prairie chicken flocks remaining in the central part of the state was on the South Farm of the University of Illinois at Urbana, where birds were reported present until 1932 by Dr. W. L. Burlison, Head of the Department of Agronomy of the College of Agriculture.

PRESENT RANGE

A survey of the range of the prairie chicken* in Illinois in 1940, fig. 1, shows two general regions of importance: about 50 square miles of sand prairie along the Green River in Lee County, northwestern Illinois, and approximately 2,600 square miles in the gray soil prairie in the southeastern counties.

To these regions may be added about 200 square miles of small occupied areas, principally in northern and south central Illinois. The total occupied territory, approximately 2,850 square miles, represents about 9 per cent of the area of grassland soils in the state, most of which were undoubtedly occupied by prairie chickens in the presettlement era.

It is evident that prairie chickens have persisted best in areas of the poorer prairie soils where fallow land or special farming practices provide more favorable environment than that in the intensively farmed areas. These birds survived longer on the heavy, dark soil of east central Illinois than on the upland prairie west of the Illinois River, probably because the east central area was poorly drained, hence less intensively farmed, until a comparatively recent date and was also less intensively grazed by livestock. Apparently the birds disappeared first from the acquired woodland range and then from the adjacent prairies, their original habitat.

It is notable that a considerable number of small, scattered colonies, in some cases now only a few dozen birds, are to be found in the dark soil counties of northern and north central Illinois, where they have persisted for many years around marshlands or other accidentally preserved habitats. However, many such isolated colonies reported by Leopold (1931) have disappeared during the past dozen years. Without intelligent management, it is extremely likely that all of the remaining colonies in northern Illinois will eventually be lost. In southeastern Illinois, the prospects for the survival of prairie chickens are better, although the outcome there depends chiefly on future agricultural developments and the conservation policies pursued with respect to these birds.

Nine major types of farming areas in Illinois are defined by Case & Myers (1934), fig. 2, who state, "By 'type-of-farming area' is meant an area in which one or more dominant types of farming can, in most cases, be easily distinguished and within which natural agricultural resources and biological and economic conditions are highly uniform."

Reference to the distribution map, fig. 1, and the map showing the major types of farming areas in Illinois, fig. 2, will show that the chief Illinois prairie chicken range lies almost entirely in the southeastern mixed farming section, Area 7, with the largest part of it lying in the central portion, Area *7b*, which is the most important center of redtop seed production in the United States. The range extends well into Areas *7a* and *7c*, although redtop, *Agrostis alba* Linnaeus, is grown somewhat less extensively and the ratio of prairie soil to woodland type soil is smaller there than in *7b*. Fig. 3 shows typical prairie chicken range in Area *7b*.

Area 7 is in the so-called "gray prairie" soil region of southeastern Illinois, characterized by light-colored silt loams and poorly drained, tight clay subsoils. These soils are of relatively low productivity and are strongly acid. Because of acidity as well as poor drainage, they are not suited to growing leguminous hay crops unless heavily limed. Case & Myers (1934) state, "The low yield of grain crops on untreated land in Area 7 and the cost of liming has led to the replacement of grain crops with redtop, which

*Throughout this paper the term *prairie chicken*, as it relates to Illinois birds, refers to only the greater prairie chicken, *Tympanuchus cupido americanus* (Reichenbach).

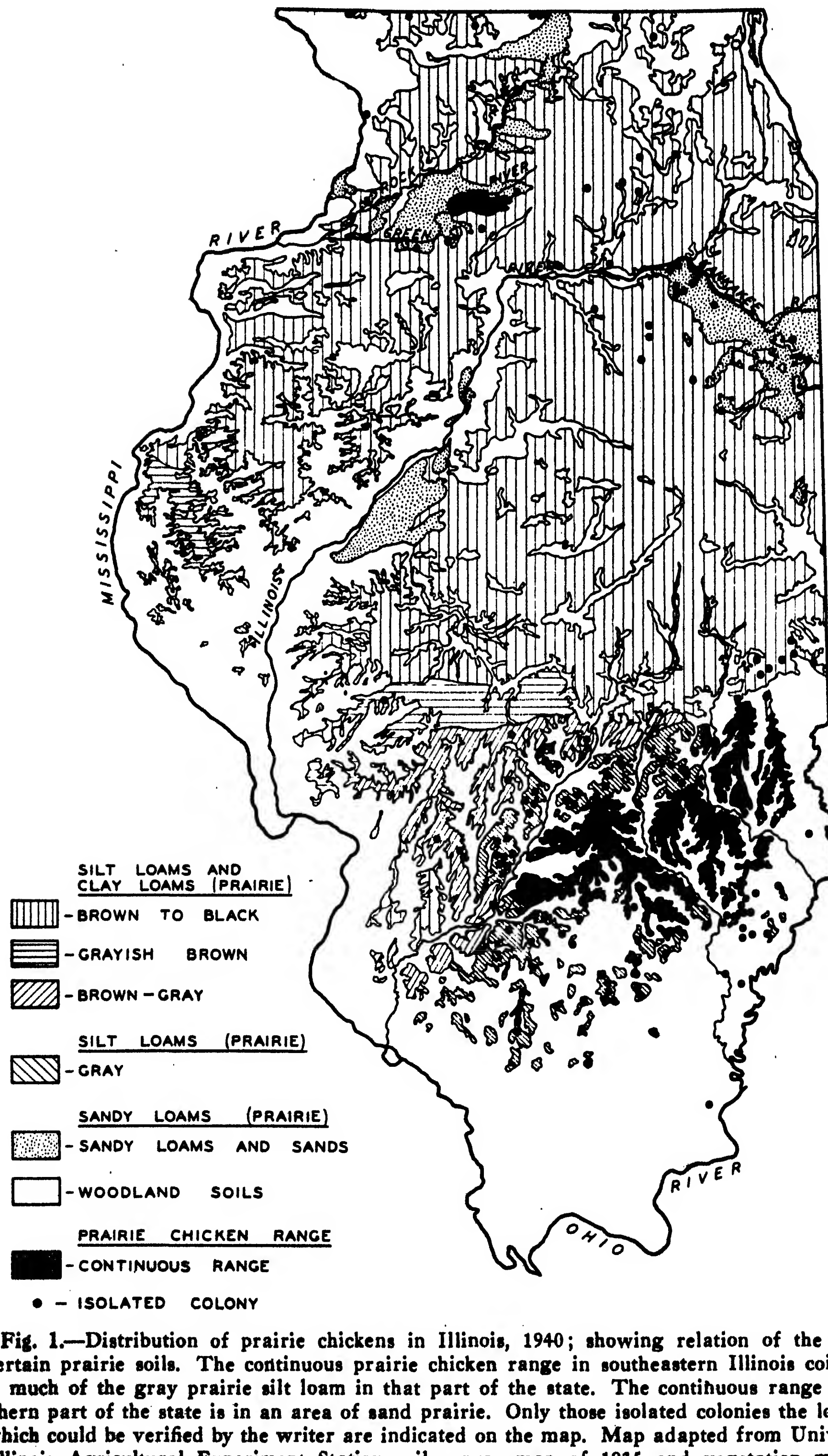

Fig. 1.—Distribution of prairie chickens in Illinois, 1940; showing relation of the range to certain prairie soils. The continuous prairie chicken range in southeastern Illinois coincides with much of the gray prairie silt loam in that part of the state. The continuous range in the northern part of the state is in an area of sand prairie. Only those isolated colonies the location of which could be verified by the writer are indicated on the map. Map adapted from University of Illinois Agricultural Experiment Station soil survey map of 1935 and vegetation map by Vestal (1931).

can be grown at little cost, and with special crops such as fruit."

Grown in southern Illinois since about 1875, redtop may be either a seed or hay crop. The seed is one of the chief cash crops of the region.

Burlison, Stewart, Ross & Whalin (1934), who state that approximately 85 per cent of the world's redtop seed and 95 per cent of the redtop seed produced in the United States are grown in south central Illinois, point out that the concentration of redtop production in that region has been due to a combination of economic factors, favorable climate, and soils not well adapted to other crops.

The cropping system practiced in Area *7b* is illustrated by the following approximate percentages of acreage in various crops and idle land in 1929: corn 18 per

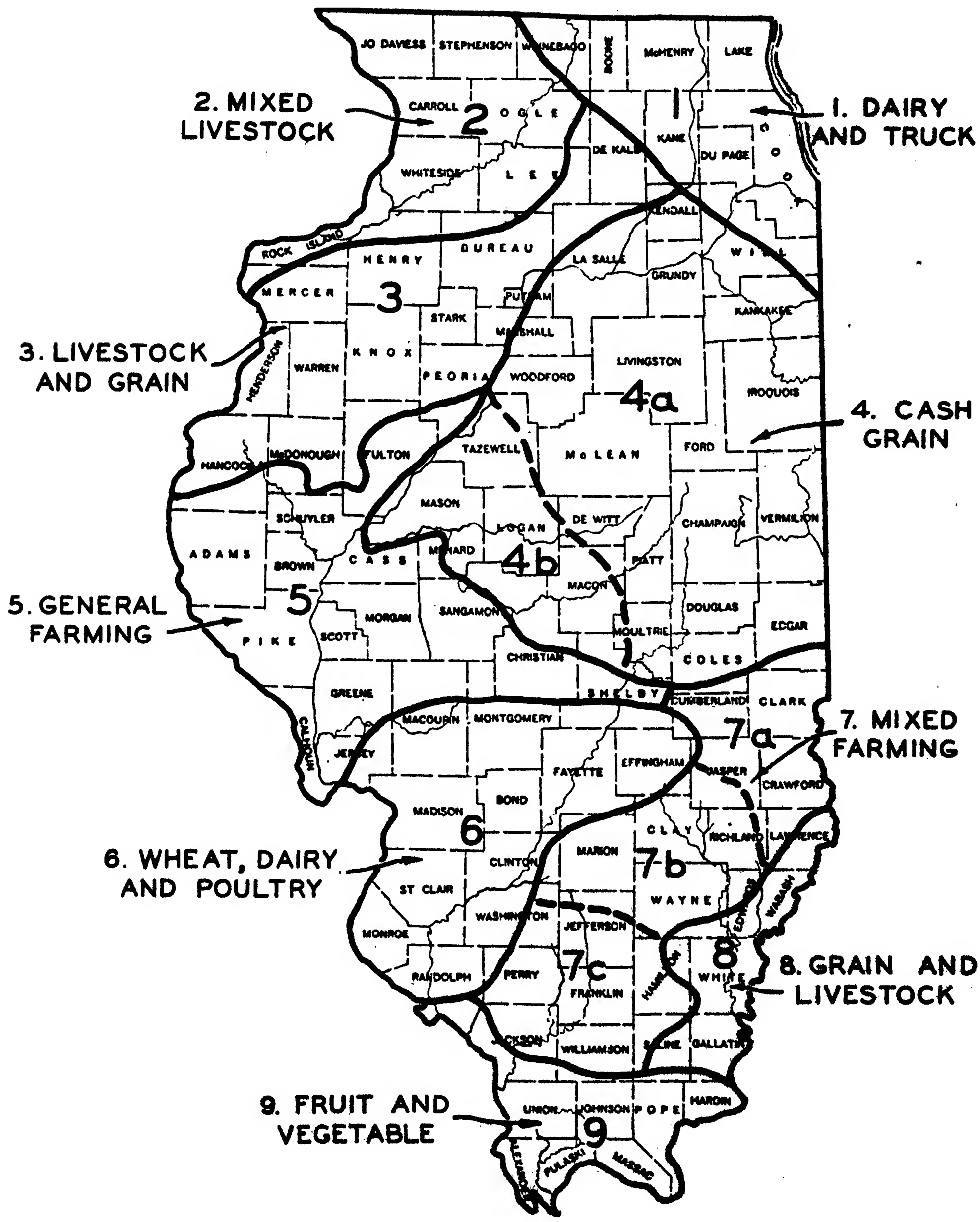

Fig. 2.—Nine major types of farming areas in Illinois. After Case & Myers (1934).

cent, small grains 5 per cent, hay (chiefly redtop) 24 per cent, other crops 8 per cent, pasture 28 per cent and idle land 17 per cent (see the graph on page 160, Case & Myers 1934). In recent years, the amount of idle land has declined to about 7 per cent, and soybeans have come into use, chiefly as a hay crop.

Probably no other locality in the state has maintained its native wildlife as well as the gray soil prairie region of southeastern Illinois. Birds nesting in numbers there in redtop and fallow fields include prairie chickens, quails, upland plovers, marsh hawks, meadowlarks, horned larks, Henslow's sparrows, field sparrows, grasshopper sparrows and several others. On the flat uplands of this region, in addition to numerous osage orange hedges, young pin oak, shingle oak, blackberry, raspberry, hazel, panicle dogwood and other cover species are common in many fencerows and waste areas. This cover, figs. 4 and 5, in connection with cultivated grain crops, redtop and fallow fields, makes this area so favorable for quails and rabbits that it attracts hundreds of hunters each fall.

Wildlife populations, especially of the brush-inhabiting species, are of course affected by the amount of idle land and brush present. This varies with economic conditions. The trend under present relatively high prices for agricultural products is toward cleaning up fencerows and thickets. As a result, quail populations have been reduced somewhat in the past few years. The recent increase in the amount of soybeans grown in this region and low prices for redtop seed have made inroads on the acreage of redtop and idle land. However, this development does not at the present time appear to have caused an appreciable reduction of prairie chicken numbers.

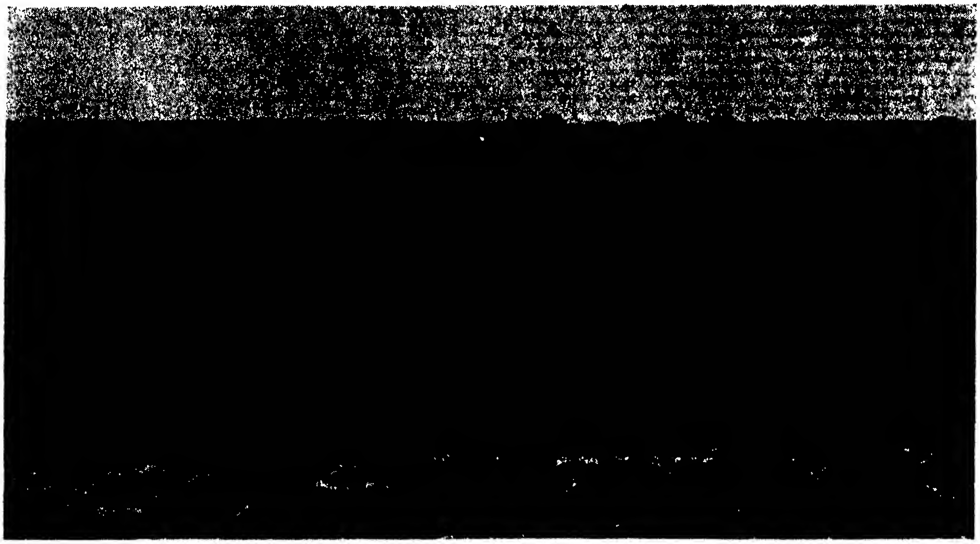

Fig. 3.—The type of farm land occupied by prairie chickens in southeastern Illinois.

Although there can be little doubt that Illinois prairie chickens inhabited cleared woodland soils to a considerable extent during the period of crude agriculture, these birds are at present confined almost entirely to prairie soils. Bennitt's (1939) map of the distribution of prairie soils and prairie chickens in Missouri shows the close relationship of the remaining range to certain types of prairie soils in that state. In southeastern Illinois, where there is extensive interspersion of woodland soil areas with the prairie or grassland soil areas that harbor prairie chickens, as a rule the only woodland soil farms on which chickens are found are those that immediately border the prairie.

One explanation for the apparent preference of Illinois prairie chickens for prairie soils may lie in the density and composition of grass and herbaceous growth, as well as in the type of plant succession, found on the prairie. Visual appraisal of

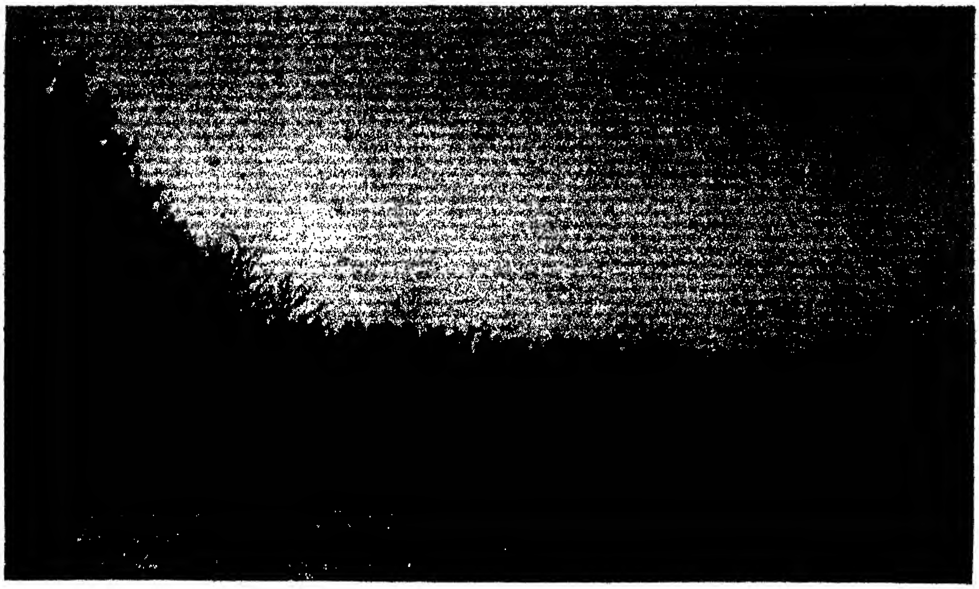

Fig. 4.—Cover used by small game in southeastern Illinois; a growth of young pin oaks, shrubs and berry vines along a stream.

typical areas of vegetation on prairie and on woodland type soils gives the distinct impression that the cover requirements of the prairie chicken are met more adequately at present by the prairie growth than by vegetation found on woodland type soils. Redtop, for example, on the prairie usually makes somewhat better ground cover than on woodland type soils; the older redtop fields on the prairie develop typical patches of dewberries and herbaceous plants that provide favorable nesting places, especially along the margins, while redtop stands on woodland type soils sel-

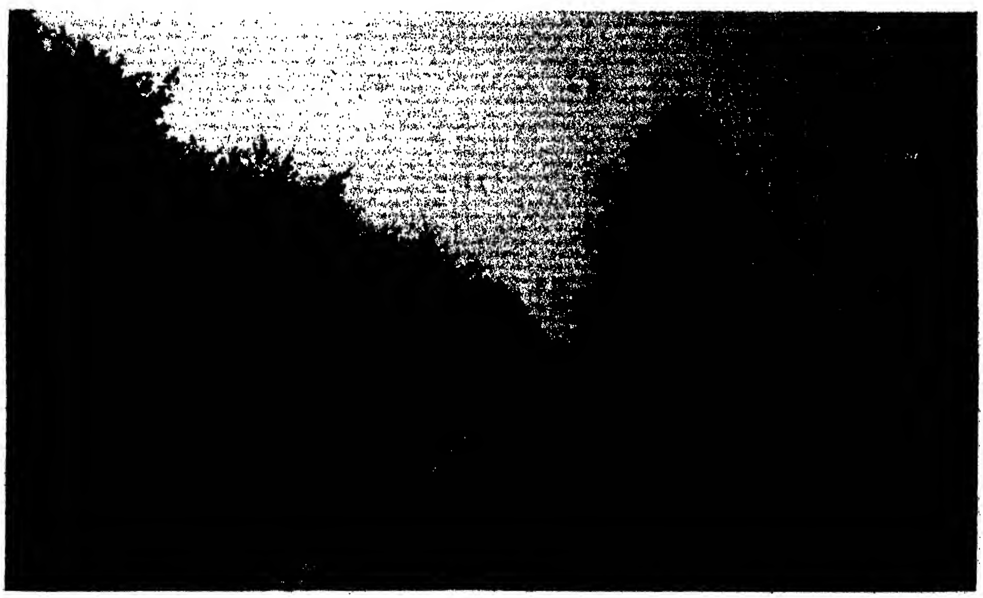

Fig. 5.—Cover used by small game in southeastern Illinois. The dense growth on the left is an osage orange hedge. The larger tree on the right is a shingle oak.

dom furnish such favorable combinations of vegetation.

The importance of uncultivated areas, especially grassy areas, in prairie chicken management is stressed by Gross (1930), Leopold (1931), Bennitt & Nagel (1937), Hamerstrom (1941), Grange (1941), Lehmann (1941) and others.

Because soils comprising the present major range of the prairie chicken in Illinois are of relatively low agricultural value, the percentage of land that lies idle annually is higher there than in the better portions of the prairie. This uncultivated land, which furnishes a certain amount of cover and food, must be regarded as a contributing, but secondary, factor in the successful stand of prairie chickens in southeastern Illinois, since these birds are maintaining themselves in fair numbers in certain redtop-producing localities where there is practically no idle land.

During the present study it became increasingly apparent that the redtop crop grown in a dozen counties in southeastern Illinois was admirably adapted to meet the cover and space requirements of prairie chickens at various times of the year, including the period of the elaborate courtship performance. Of paramount importance is the fact that harvesting of the redtop crop is not begun until approximately July 1 or July 15, depending on whether the redtop is grown for hay or seed. Because of the lateness of the harvest, redtop provides a habitat somewhat like the native prairie during the critical nesting period and while the birds are very young.

Contrary to the common belief that prairie chickens will thrive only where tracts of wild lands remain, in southeastern Illinois these birds are found in fields close to farm buildings, where they are in frequent contact with domestic turkeys and chickens, thus providing noteworthy evidence of a potential adaptability to settled communities.

Although, in some instances, prairie chickens have persisted for long periods in dark soil prairie districts, where up to 85 per cent of all farm land is plowed annually, their rate of reproduction in most districts of this type has been too low to prevent their ultimate disappearance. The farming practices now widely employed in dark soil prairie regions do not provide the habitats essential to prairie chickens, and, unless conditions change markedly, the less fertile prairie soils will continue to be the chief range of these birds in Illinois.

LIFE HISTORY

The life history of the prairie chicken has been studied in detail by several workers whose observations are acknowledged below. Many of the findings of these workers have been verified by field work, principally on the Jasper County study area in southeastern Illinois, which has yielded new as well as supplementary information.

Sexual Cycle

In southeastern Illinois, male prairie chickens, while still in winter flocks, may show the first evidence of the mating display during mild weather as early as late January or the first few days of February. At first this activity consists of fighting, strutting and loud cackling, but a few days later the first characteristic booming, fig. 6, may be heard from the booming grounds. The earliest date booming has been heard by the writer is January 30, in 1939.

Fig. 6.—Male prairie chicken at the climax of the booming performance.

For several weeks after the first males appear on the booming grounds, flocks of chickens, consisting apparently of both females and those males that have not yet

begun to display, are commonly seen staying close to the booming grounds. On March 1, 1939, apparently less than 10 per cent of the total prairie chicken population of the Jasper County study area were males in which the booming and displaying performance was fully developed.

In an intensive study of the breeding habits of prairie chickens in Wisconsin,

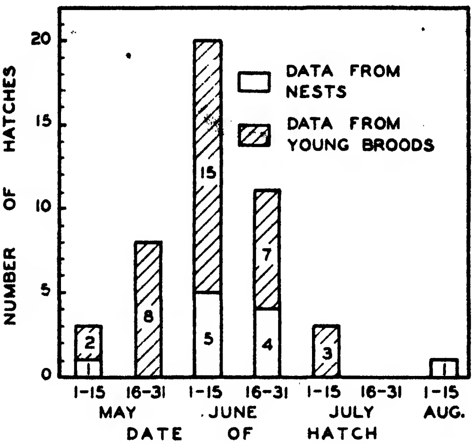

Fig. 7.—Hatching period of prairie chickens on the Jasper County study area, chiefly in 1935 and 1936. Some of the hatching dates were obtained from nest observations and others were calculated from careful estimates of the ages of young broods encountered in the field.

Hamerstrom (1941) brought out many behavior details that apply substantially to southern Illinois chickens.

Hamerstrom found evidence that the males, and probably the females, do not all arrive at the breeding stage at the same time, but rather show a spread of several weeks in the stage of development of the sexual cycle, a characteristic noted by other investigators in one or both sexes of certain other gallinaceous birds. Studies of the behavior of prairie chickens in southern Illinois indicate that such a time lag in the development of the sexual cycle exists among birds of both sexes.

In male birds the development of the sexual cycle during early spring is accompanied by a gradual increase of the yellow pigmentation of the neck and eye regions, as well as by an increase of booming and fighting. Considerable difference in the development of these manifestations has been commonly noted among males on and near the booming grounds. In the latter part of the breeding season, this differential development of the cycle is indicated by the gradual disappearance from the booming grounds of males that apparently are becoming sexually inactive. In southeastern Illinois, the period of greatest booming activity appears to be about the last week of April. By May 10 a lessening of display is usually evident. By early June only a small fraction of the peak number of males is still present on the booming grounds. By the second week of June the booming period is practically over.

The hatching period for the prairie chicken in southeastern Illinois is indicated by the accompanying graph, fig. 7. This graph, which shows the distribution of prairie chicken hatching records obtained in Jasper County, chiefly in 1935 and 1936, is based partly on nests under observation and partly on coveys of young birds encountered in the field. Hatching dates of the coveys were calculated from careful estimates of the ages of the young birds.

It will be seen that, in the years included in the graph, hatching began during the first half of May, reached a peak during the first half of June and tapered off during the first half of July. Although the later hatches probably in part represent renestings after failure of earlier attempts, the total evidence from observations on females at the booming grounds and accumulated field records on the beginning of nests supports the belief that considerable variation exists among females as well as males relative to the time at which breeding takes place. On the whole, such an extended breeding cycle appears to be a useful adaptation by the prairie chicken to its fluctuating and often unfavorable environment, where poor cover, activities of enemies or unfavorable weather might otherwise at times cause heavy losses of nests or very young birds.

Cold, stormy weather delays the start of the mating display among prairie chickens. Later it may cause a temporary halt of sexual activity and even a return of winter flocking habits. It is possible, also, that cold weather or other unfavorable weather conditions may delay the start of the breeding season. Although the tend-

ency for southeastern Illinois prairie chickens to form large flocks is usually over by the third week in March, it was noted in 1940, following a cold, rainy April, that many birds were showing a tendency to flock as late as the first week in May. The breeding season, usually at its height at this time, was apparently held back by unfavorable weather conditions.

Booming

Booming grounds in southeastern Illinois are usually on slightly elevated terrain, but in northern Illinois they sometimes occur on level bottoms of potholes or near the edges of ponds. On the pond sites, a rise of an inch or so of water may fail to drive the male birds from their established territories. The favorite place appears to be a pasture or meadow where the vegetation is short. Booming grounds have been observed also on winter wheat fields, idle fields, stubble and bare ground. When the grounds are plowed during the mating season, the birds may continue to boom on the plowed soil.

The chief booming periods during the height of the season are for 3 or 4 hours after dawn, and from late afternoon to near dark. These periods are marked by continuous strutting, booming, cackling and fighting between pairs of male prairie chickens.

The booming is a resonant, three-syllabled call, described by Grange (1940) as "Zooooo . . . woooo . . . youoo," the second syllable lower than the first and the third rising above the first. These calls given by several birds at once blend into a continuous tone of near trumpet-like quality that can often be heard for well over a mile. In early morning when three or more groups are heard booming simultaneously, the effect produced is like the droning of a huge hive of bees.

It has been generally assumed that, during the booming performance, the female birds in the vicinity are attracted and that mating takes place at the booming grounds, but, although occasional matings are observed there, the studies of Hamerstrom (1941) and Main (1937) indicate that the bulk of mating activity may take place off the main booming grounds.

Although the same booming ground may be used for several years, it is a common occurrence in southeastern Illinois for chickens to shift after a year or two to a new site in an adjacent field, or for a group to appear in early spring at some distance from a previously used site. Only 1 of approximately 20 booming grounds under observation each spring in southeastern Illinois has been used continuously for as long as 7 years. Undoubtedly, farming operations account for many of these shifts.

The average number of males per booming ground in and near the Jasper County study area apparently has varied only slightly from year to year. However, the number of booming grounds in use has shown considerable variation from year to year, corresponding to population changes. For example, in late April, 1939, when there were 12 booming grounds on the study area having 4 or more males, the average number of males per booming ground was 9.9. In 1940, on 7 booming grounds having 4 or more males, the average number of males was 8.9, and in 1942, when there were only 6 booming grounds, the average number of males was 9.3. It was noted in southeastern Illinois that during the summer months, after the booming season, certain groups of adult males tended to stay together in the vicinity of the booming grounds; a similar tendency is recorded by Hamerstrom (1939) in Wisconsin.

The largest number of displaying males seen on any established booming ground in southeastern Illinois is 24; however, the maximum number observed during any spring has seldom exceeded 17 or 18. Not infrequently single birds or pairs take stations at some distance from regular booming grounds and go through the courtship display daily for weeks.

It was observed in the spring of 1939, following a marked increase in the prairie chicken population of southeastern Illinois, that new booming grounds were established in a poorly drained part of the study area which had been little used by the birds during any previous spring. Subsequently, when the population of the study area declined, some of the new booming sites continued in use, while certain older grounds were abandoned. It is possible that these new booming grounds were formed chiefly by young males, some of which returned to them during the

following years. The presence of males on the new booming grounds apparently attracted females and led to the establishment of a local population on a previously unused portion of the study area. A similar sequence in the establishment of new colonies was observed by Franklin J. W. Schmidt (Leopold 1933) during his study of prairie chickens in Wisconsin.

Flocking

During the first few weeks after hatching, the prairie chicken young are kept closely concealed by the females. By the first week in June in southeastern Illinois, occasional early hatched broods, about 3 weeks old, can be observed. However, the best opportunity to observe the young comes after the redtop is harvested in mid July. A tendency for broods to combine loosely is evident in midsummer. It is not uncommon in late July and August to see two or more females together with young of different sizes. Such combination broods were observed with field glasses several times during field work in the summer of 1936, and on August 11, 1936, two young, one apparently about 5 weeks and the other 8 weeks old, were collected from the same flock.

Although single broods or small combined groups are in evidence throughout the summer, the flocking tendency becomes more evident toward fall. For example, on Aug. 17, 1937, 33 birds feeding in a southeastern Illinois bean field combined into a single flock when flushed. By October, although most of the chickens flushed are in flocks of less than 20 birds, the tendency to form large temporary flocks is evident; as many as 50 birds have been seen together by Oct. 15. In late autumn and winter, flocks ranging from a dozen to 75 birds are common. The largest winter pack seen by the writer in Illinois was approximately 110 birds, counted in flight in Jasper County, on Feb. 10, 1942. Despite the flocking tendency, some small groups or single birds are always encountered during winter field work.

Movements

Leopold (1931) gives several records showing winter migrations of prairie chickens from northern districts to areas at least as far south as central Illinois. The latest date of migration of large numbers of chickens given by Leopold was 1908; it related to a large flight southward through western Peoria and eastern Knox counties. Since this flight occurred in early fall, it may have consisted of local rather than northern birds. Leopold quotes a statement made in 1874 by A. H. Bogardus that in Logan County, in the latter part of the fall, chickens were then nearly as numerous as in the late '50's, but young birds in August and September were said to be much less numerous than formerly. A former practice by market hunters of shooting prairie chickens during their southward flight along the Mississippi bottoms in Henderson County is mentioned by Leopold.

Reports received by the writer from old time residents of the east central part of Illinois indicate that up to 50 years ago, or later, flocks of migrating prairie chickens were still occasionally encountered in that part of the state in winter.

Recent censuses of the Jasper County study area show that local fall and early spring movements of prairie chickens occur regularly in that locality. The south slope of a low hill which covers about a third of this area has for many years been a favorite wintering ground for prairie chickens, and each year an influx of at least a few dozen birds, apparently from nearby areas, to this spot has been noted, fig. 8. The most noteworthy concentration occurred in the winter of 1938-39, when local populations were at the highest point reached during the period of investigation, 1935 to the present time.

A census of the 4-square-mile study area concluded on Nov. 9, 1938, showed a total of approximately 255 prairie chickens. By the end of December, birds appeared to be much more numerous than in November. A second census in late February and early March, 1939, showed that the population had risen to nearly 400 birds. By mid March it was evident that a considerable number of birds had left the area. A March dispersal of birds from their wintering grounds has been observed repeatedly during the study. This appears to have been chiefly a local movement, affecting only the birds in the vicinity of the study area. However, since

little banding has been done, the full extent of movement of birds in this region is unknown.

Cover Requirements

Although prairie chickens in southeastern Illinois inhabit a variety of crop or pasture lands, as well as suitable waste areas, they show a preference for redtop fields at most seasons; the growing redtop in early spring and its stubble in autumn and winter furnish favored resting places and fair concealment.

Daytime Cover.—When newly hatched, the young chickens are kept by the females chiefly in redtop fields, but to some extent in small grain or grassy fallow fields. In midsummer, young and old birds feed largely in small grain stubble, redtop stubble and soybean fields. During the heat of the day, they retire to the shade of trees or small shrubs along fences, osage orange hedges and cornfields. In cultivated fields, their dusting pits are frequently seen, often each with a spreading herbaceous plant or a corn hill serving as overhead cover for the young or adult bird while dusting. In late July and August, before the young are fully developed, they have commonly been observed to fly, when flushed, to the edge of a nearby cornfield, which serves as a convenient escape cover area.

During autumn, and even in midwinter, prairie chickens spend much time in the open fields. They feed largely in cornfields, soybean fields and small grain stubble. During snowstorms they frequently seek low spots in standing corn or shocked cornfields. They have been observed during blizzards seeking protection at the bases of corn shocks.

The use made of fallow or idle fields for daytime cover depends chiefly on the stage of succession of the vegetation. Old cornfields or stubble may be frequented by prairie chickens during the first year the fields are idle, but when aster, fleabane and goldenrod cover the ground these areas are little used except in winter and early spring when such plants have been flattened. Later, when grass and brambles begin to crowd out the thick herbaceous growth, the fields may again be used as nesting and roosting areas.

Roosting Cover.—Schmidt (Leopold 1936) found that suitable roosting cover was a factor in determining the summer range of prairie chickens in Wisconsin. In southeastern Illinois, the cover selected for night roosts by female prairie chickens for their broods is usually in fields having fairly thin and low grass, sparse weed growths or open grassy spots. Nearly grown young birds sometimes use for roosts small patches of thin, uncut redtop. On cool evenings the young frequently seek a furrow, wheel track or other depression for protection from the weather.

Fig. 8.—These fields on the south slope of a low hill in the Jasper County study area are a favorite gathering place for prairie chickens in late fall and winter. Redtop stubble seen in the foreground is much used for winter cover.

In autumn and winter the birds select redtop stubble, idle grasslands or low weed growth, sometimes only 2 or 3 inches tall, fig. 9. On windy or cold evenings the adult birds, as well as the young, often select slight depressions or furrows for protection.

Nesting Cover.—During the summers of 1935 and 1936 all types of nesting cover on the 4-square-mile Jasper County area were searched carefully to determine as accurately as possible the actual use of each type of cover.

Although prairie chickens in southeastern Illinois nest in a variety of sites, they show a preference for short grass cover with scattered growths of brambles and herbaceous plants such as are found in waste areas of bluegrass, *Poa pratensis* Linnaeus, and old stands of redtop, *Agrostis alba* Linnaeus. The sites of 39 nests under observation on and near the Jasper County study area may be classified as follows.

Redtop Fields.—Redtop, which during the period of this study occupied nearly 30 per cent of the Jasper County study area, presents a larger acreage of potential nesting cover than any other kind of vegetation. As previously intimated, new seedings apparently are used less often than old stands. In 1935, when much farm land had been out of cultivation for 2 or more years, because of low agricultural prices, numerous idle fields had developed sufficient grass and dead vegetation to make them attractive nest sites. Consequently, redtop was less generally used then than in 1936 and later when some of the idle fields were put back into cultivation. Fourteen of the 39 nests under observation were in redtop fields.

Fallow Fields and Pastures.—In addition to fallow fields, this classification includes a small acreage of pasture land, amounting to about 1 per cent of the total study area, pasture land invaded by brambles or having spots of low sedge growth. The remaining pasture land is almost without exception badly overgrazed and therefore of no use for nesting sites. During the nesting study, about 18 per cent of the total land in the vicinity of the Jasper County area consisted of fallow fields or lightly grazed pasture. Twelve prairie chicken nests were found in this type of cover, of which 7 were in fallow fields, 3 were in pastures and 2 were in fallow fields that had been planted to corn the previous year.

Waste Grassland.—Small waste areas chiefly of bluegrass, not subject to grazing or farming for several years, averaged at the time of this investigation about 2 per cent of the total land acreage on the study area. This was the most intensively used type of nesting cover from the standpoint of density of nests. Thirteen nests were located in these areas, of which six were on low ditch banks, five were on an abandoned railroad bed, one on a roadside and one in a fencerow.

The choice of particular nesting sites in the waste grassland type was sometimes difficult to explain. Borders of back roads constitute the greatest area of seemingly favorable nesting cover of this type, but apparently they were little used. Ditch banks used as nesting sites were usually nearly level with the adjoining fields, and often narrow. It is evident that the stage of plant succession is an important factor in choice of site. The distance of the

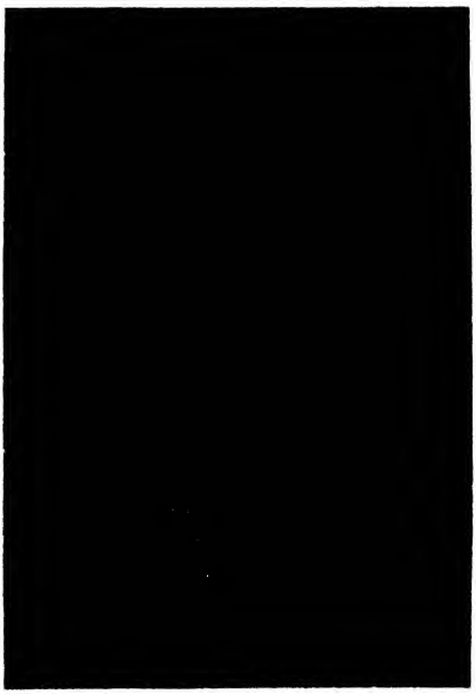

Fig. 9.—Night roosts of two southeastern Illinois prairie chickens in short grass and weeds, Feb. 9, 1940. Prairie chickens usually select slightly taller vegetation in sheltered spots for their winter roosts.

Table 1.—Types of nesting cover used by prairie chickens in Jasper County, Ill., chiefly in the summers of 1935 and 1936.

Type of Cover	Per Cent of Total Nesting Cover on Study Area	Number of Nests	Per Cent Successful
Redtop	60	14	57
Idle fields and pastures	36	12	33
Waste grassland	4	13	54
Total	100	39	49

cover from booming grounds also apparently influences the choice.

Reference to table 1 shows that, in this study, success of nests in redtop fields and in waste areas was higher than in idle fields. Although no conclusions can be drawn from the few records presented here, there is some basis for believing that nest losses in idle fields are often relatively high, due to the fact that these areas frequently are plowed after nesting has begun. Moreover, losses resulting from predators are apparently higher in fallow fields than in redtop because the former more frequently contain dens of furbearers whose early spring hunting activities include nearby open areas.

Nesting Habits

As indicated above, prairie chicken nests in southeastern Illinois are located usually in grassy sites, sometimes without any other vegetation for cover, but more often

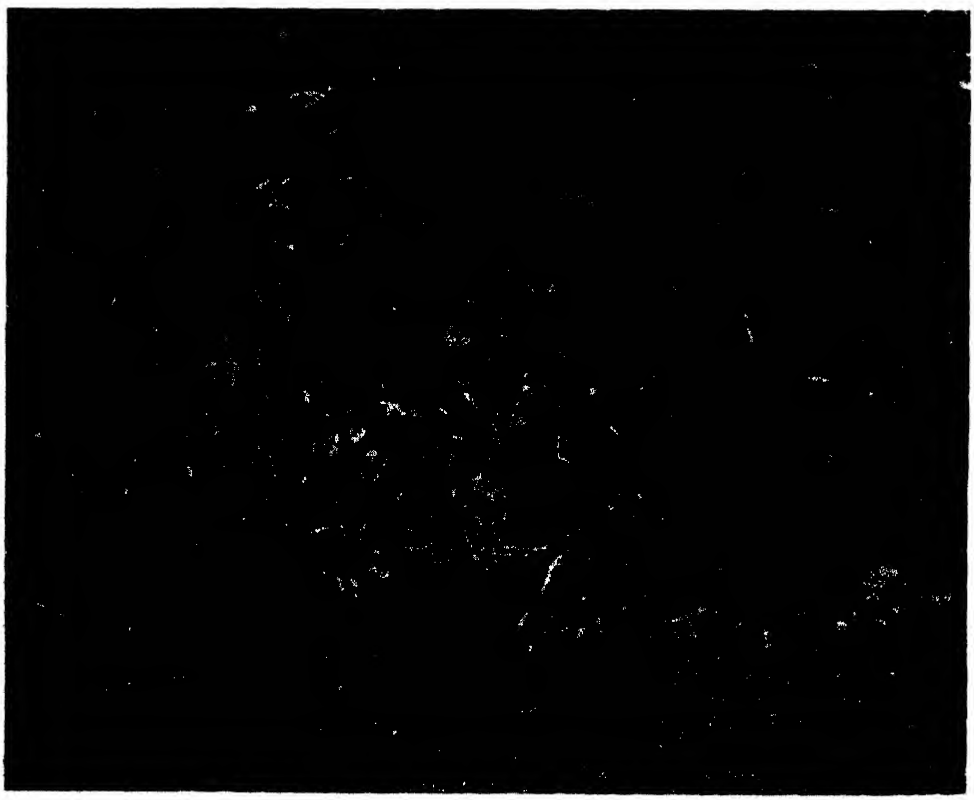

Fig 10.—Female prairie chicken incubating her eggs in a nest partly concealed by a growth of ironweeds.

with a bramble or a few herbaceous plants serving as overhead cover, frontispiece and fig. 10. Some nests are in thin growths of grass under a single stem of dewberry or rose that offers scant concealment,

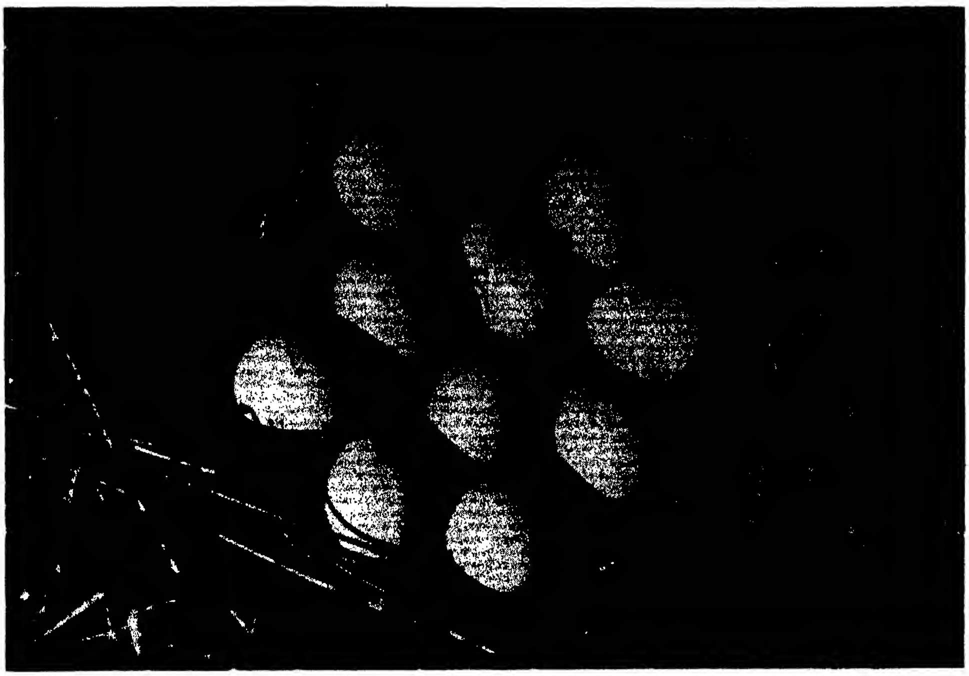

Fig. 11.—Prairie chicken nest containing 10 eggs. The overhead canopy of bluegrass and dewberries was removed while the nest was being photographed.

while others have been found in the thick grass growth of old stack bottoms in redtop fields. Tall and rank weed growth apparently is not attractive to prairie chickens.

There appears to be a definite tendency for field nests to be situated within a few feet from the field margins. Not infrequently nests are found close to hedges or small trees along field margins or streams. Gross (1930), working in Wisconsin, found that on rare occasions nests are surrounded by trees of considerable size.

Prairie chicken females occasionally lay eggs in the nests of others of their kind, making up clutches of 20 or more eggs. The largest observed clutch believed to have been laid by one prairie chicken consisted of 16 eggs. The average size of 12 clutches, most of them seen in 1935 and 1936, and each clutch laid apparently by a single female, was 12.3 eggs. Fig. 11 shows a nest containing 10 eggs.

Nine of 23 prairie chicken nests reported on by Hamerstrom (1939) in Wisconsin were within a half mile of a booming ground, and 10 were between a half mile and a mile and a quarter. The distances from the other 4 to the nearest booming ground were unknown. In southeastern Illinois, where booming grounds are apparently much closer together than in the area in which Hamerstrom worked, the relationship of outlying nests is difficult to determine, but a definite tendency for nests to be grouped close to booming grounds was evident. The great majority of nests found on the Jasper County study area were within a radius of a quarter mile from the nearest booming ground; and wherever favorable nest sites were available on the Jasper County area a number of nests were found between 150 yards and 330 yards from a booming ground.

Nest Concentrations

Reports received from observers who recall conditions in southeastern Illinois 60 years or more ago indicate that large numbers of prairie chicken nests were

sometimes found in relatively small areas of nesting cover. Leopold (1933) mentions reports of former concentrations of nests in Iowa. Johnson (1934) recalls a tract of about 10 acres of unbroken prairie near his home in Marshall County, Minn., where numerous prairie chicken nests, both old and new, were disclosed by a spring fire. These instances seem to be associated with fairly high populations and the occurrence of areas of choice nesting cover in localities in which much of the nesting cover had deteriorated as the result of agricultural practices. Nevertheless, in view of the observed preference of prairie chickens for certain vegetative types, it does not seem unlikely that nest concentrations may sometimes have occurred on the virgin prairie.

Although there was ordinarily no marked tendency for nests to be grouped together on the Jasper County study area, in at least one instance favorable nesting cover was responsible for the selection of a number of nesting sites within a limited area. In 1936 a booming ground used by about 7 males was located slightly more than an eighth mile from a small area of grassland, the margins of which were being invaded by blackberries. This tract, about 200 yards long and less than 100 yards wide, approximately 4 acres, included part of a lightly grazed pasture, a small fallow area and a strip of bluegrass along a creek. A search of this cover in June revealed four prairie chicken nests. Since no other nests were found nearby, it seems probable that nearly all, if not all, of the females in that locality were nesting in this small area. By May 1, in Jasper County, redtop has usually made sufficient growth to invite nesting, and after this there is probably less tendency for nests to be grouped in small bluegrass areas.

Causes of Nest Losses

Although of 39 nests under observation in Jasper County, 19, or 49 per cent, were successful, table 1, it is significant that of the 20 unsuccessful nests 7 were abandoned or destroyed early in the season when only one to three eggs had been laid. There is considerable reason to believe that in such cases new nests are begun within a few days. Indications are that in southeastern Illinois a comparatively high percentage of the females finally bring off broods successfully, because of renestings and a general increase of the quality and quantity of nesting cover as the breeding season advances.

It is of interest to note in this connection that, although field studies in 1935 and 1936 showed an occasional attempted renesting as late as July, there was no evidence that nesting attempts begun after the first week in June added a significant number of young birds to the crop. Apparently redtop cutting during July finds the hatching period nearly over and most of the nesting attempts ended, fig. 7.

The causes of 19 out of 20 nest failures were known or could be determined from evidence at the nest. Predators destroyed seven nests, desertion was responsible for the loss of six, farming operations destroyed five, one full clutch was apparently infertile and one nest from which three or four eggs had disappeared was listed as failing for an undetermined cause.

Predators.—Clutches laid in April in poor cover were found to suffer fairly high losses from crows and furbearers. Thirty-five per cent of the nest losses observed in this study were due to predators. In addition, broken shells, showing beak or teeth marks, were frequently found on the ground, and the nests from which they had come could not be located. Egg shells were sometimes found along hedges where they had apparently been dropped by crows. In southeastern Illinois, possibly crows take more eggs than any other one species, but, since prairie chickens frequently lay an egg or two in exposed places early in the season, it is difficult to say how much of the crows' activity is actual nest robbing.

Furbearers hunting widely over meadows and crayfish flats in early spring destroy a number of exposed nests. Apparently, skunks, opossums and, on occasion, minks and raccoons are guilty of nest robbing.

The role of snakes as nest robbers in this region is undetermined, but probably certain species take some toll.

In southeastern Illinois, growth of vegetation by early May usually restricts the feeding areas of most predatory species, and, as a result, nest losses from predators become of minor importance. Under these circumstances, the effect of egg predation

seems to be chiefly to delay the nesting season.

Desertion.—Nest desertions in the Jasper County study area occurred chiefly early in the nesting season, and usually when only a small number of eggs had been laid. Apparently at the beginning of their nesting efforts the females are very wary and desert as the result of even slight disturbances. Later, when the incubation period is well under way, they do not desert their nests readily when disturbed.

Farming Operations.—Plowing of grass or idle fields in May and June for corn or soybeans is the chief nest hazard to Illinois prairie chickens from agriculture. However, spring burning of idle fields in 1936 was known to destroy Jasper County quail nests and doubtless was responsible for considerable loss of prairie chicken nests. Fortunately, burning has not been widespread since that year, when a large acreage of idle land was put back into cultivation.

Failure to Hatch.—Romanoff, Bump & Holm (1938) state that fertility of eggs of upland game birds depends on the conditions of mating, the health and activity of male and female birds, and upon several other physiological and environmental factors. These authors point out also that the hatchability of fertilized eggs is dependent on their inherent vitality and nutrition and the environmental conditions of incubation. They found experimentally that the critical stages during which death of the embryos of pheasants, grouse and quails occurs most frequently are the fourth, the twelfth and about the twenty-second days of incubation.

Field evidence as to the fertility of prairie chicken eggs, the mortality of embryos and the effect of environmental conditions on the hatching of eggs is limited because of the relatively small number of nests observed. Only one clutch that was apparently incubated normally failed entirely to hatch, in this case seemingly because of lack of fertilization of the eggs. In two clutches nearly ready to hatch, known to have been exposed for several hours during periods of high air temperature and low humidity in each case, the majority of the young failed to emerge from the shell probably because of drying of the egg membranes. In 12 clutches judged to have undergone normal incubation, approximately 93 per cent of the 148 eggs hatched.

Weights

While trapping prairie chickens in southeastern Illinois in January, 1940, Robert E. Hesselschwerdt, then employed by the Illinois Natural History Survey on Federal Aid in Wildlife Restoration Act projects, and Lynn H. Hutchens, then of the Forest Preserve District of Cook County, obtained the weights of 27 live, adult birds. The prairie chickens were in good condition, but some of them had been held in the traps for 10 or 12 hours before being weighed and had undoubtedly lost a few ounces.

The live weights obtained by Hesselschwerdt and Hutchens are as follows: average weight of males (20 specimens), 2 pounds 4.7 ounces; heaviest male, 2 pounds 13.6 ounces; lightest male, 1 pound 15.2 ounces; average weight of females (7 specimens), 1 pound 12.5 ounces; heaviest female, 1 pound 15.2 ounces; lightest female, 1 pound 6.4 ounces.

POPULATION STUDIES

It was recognized at the outset of the present study that knowledge of at least the gross aspects of the behavior of prairie chicken populations in Illinois was necessary in order to outline an adequate management program. This recognition led to the collection of a large number of population records, including field notes and reports received from qualified observers in different parts of the Illinois prairie chicken range. In addition, fall, winter and spring censuses of the birds on the 2,560-acre study area in Jasper County were conducted each year from autumn of 1935 through the spring of 1942.

Prairie chicken population trends in northern Illinois are discussed elsewhere in this report. This section deals with the behavior of chicken populations in the principal range in southeastern Illinois.

Although censusing of the study area during three different seasons yielded useful information on movements and population densities of prairie chickens, it became evident that the fall and winter censuses were less reliable as indices of

population trends than the booming ground censuses taken in April. For example, the study area proved to be a favorite wintering ground for prairie chickens, and each year, in early winter, an influx of birds occurred from nearby farms, causing the population level there to rise above that of the surrounding range. In autumn the relatively high mobility of chicken flocks caused some variation from day to day in the number of birds present on a given area of farmland,

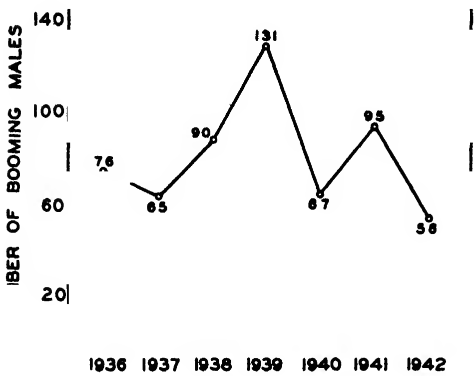

Fig. 12.—Trend of male prairie chicken populations on a 2-by-2-mile area in Jasper County, 1936-1942, shown by booming ground censuses.

although the figures obtained during the fall censuses were undoubtedly more nearly representative of normal populations than those from the winter censuses. The fall censuses, taken annually from 1935 through 1941, usually in late October or early November, showed an average population during the 7-year period of 179 birds present on the area. The largest number of birds shown by any fall census was 255, in 1938, and the smallest number was 141, in 1939. These figures represent a variation in fall population densities of from about 1 bird per 10 acres to 1 bird per 18 acres. The average was approximately 1 bird per 14.3 acres.

The results of the censuses of male birds on the booming grounds of the Jasper County study area are shown in an accompanying graph, fig. 12.

Since the number of males on any particular booming ground is never constant throughout the season, every effort was made to take the census at the height of the booming season, usually in late April. Hamerstrom's (1941) work clearly shows the need for care in this respect. The booming census is subject to criticism in that it does not include the female birds; our efforts to determine sex ratios by trapping in late winter were unsuccessful due to the fact that a disproportionately large number of males were found to enter the traps. Nevertheless, field experience indicates that the census of booming males provides a usable and reasonably accurate index of local prairie chicken populations.

Davison (1940) used the booming ground census extensively in connection with his study of the lesser prairie chicken, *Tympanuchus pallidicinctus* (Ridgway), in Oklahoma. By comparing results obtained on census areas of different sizes, he concluded that the minimum area that could be censused as representative of any locality is 2 by 2 miles, and that census figures from areas 3 by 3 or 4 by 4 miles are more dependable.

The Jasper County census area, 2 by 2 miles, represents the smallest unit indicated by Davison's study as representative. The census was begun there in 1935 to determine population trends in an area for which weather records and field studies on subjects related to the welfare of prairie chickens were available. Since the distribution of these birds is spotty in the mixed prairie and woodland districts of southeastern Illinois, it seemed advisable to confine the census to a relatively small area lying within the better range.

It is of interest to note that there was considerable similarity between the population fluctuations on the study area as shown by booming ground censuses and the fluctuations indicated by field records and reports from other parts of the southeastern Illinois range. For example, a decrease in the fall of 1936, corresponding to that indicated by the 1937 booming ground census of the Jasper County area, was reported to the writer by a number of observers throughout southeastern Illinois. In Missouri, Bennitt (1939) reported a decrease of prairie chickens in 1936. The "high" of 1938 was amply confirmed for other localities in southeastern Illinois, as well as the study area, by field observations, by reports received from farmers and hunters, and by subsequent agitation for an open season. The

population decline of 1939, shown by the 1940 booming ground census, was marked by the absence in the fall of 1939 of the numerous large flocks seen in various parts of southeastern Illinois during the previous fall and winter. Surprisingly, on the study area, where the booming ground census of the spring of 1939 had shown 131 male birds present, the census taken the following fall showed a total of only 141 birds of both sexes. Although the foregoing records indicate considerable variation in prairie chicken populations from year to year, when several consecutive seasons are considered there is no indication of recent major changes in the average density of these populations in the main parts of the range in southeastern Illinois. Undoubtedly, in recent years, there has been an increase in the total number of prairie chickens in this region, but this is due to extensions of the range into unoccupied territory rather than to building up of local populations.

Prairie chickens have been found to undergo cyclic fluctuations over a wide area in their acquired range in the northern Lake States (Leopold 1933), but relatively little evidence has been published on the subject of cycles in the Central States. Bennitt (1939) states that the type of population fluctuation of prairie chickens in Missouri is uncertain; it seems doubtful to him if Missouri birds are cyclic. Leopold (1931) cites a record of high chicken populations in Crawford County, southeastern Illinois, about 1920, but elsewhere in the same publication he states: "The question of early cycles must be left unanswered for Iowa, Minnesota, and Illinois. In Indiana, while the early behavior is unknown, there is a clear and convincing record of one fluctuation which I have called the 'comeback of 1912.'" That the increase of prairie chickens reported in Indiana in 1912 extended into Illinois is indicated by the following quotation from Forbes (1912): ". . . prairie-hens—thanks to our protective laws—are now to be seen in at least seventy-four counties, so abundantly in some that farmers are beginning to protest against their further increase because of the amount of grain which they devour." As previously mentioned, this gain proved to be a temporary one.

The average length of cycle of the prairie chicken and other grouse in the northern tier of states and Canada is believed by Leopold (1933) to be about 10 years. If the high populations reported in Illinois in 1912 and 1920 are to be regarded as manifestations of a cycle, another "high" would then be expected to occur about 1930. The writer has received reports from a number of observers indicating the reappearance at about this time of prairie chickens in certain southeastern Illinois localities from which the birds had previously been absent. However, these reported extensions of prairie chicken range may have been due to the improvement of local habitats since, as the result of low agricultural prices, large acreages of farmland were then lying idle.

The marked increase of prairie chickens in southeastern Illinois from 1936 through the breeding season of 1938 was plainly not related to changes in the habitat, since it occurred during a period when much idle land was being put back into cultivation. Viewed in the light of the two previously recorded high periods, the increase of chickens in 1938 suggests the possibility of the recurrence of a cyclic "high." It is of some interest that the 1938 peak occurred 26 years, or somewhat less than the equivalent of three average cycles of northern grouse, after the "high" of 1912. The 1938 peak was followed by an abrupt decline the next year. Population densities have fluctuated somewhat irregularly since 1939, but they have not again reached the 1938 level.

Records on fluctuations of cottontail rabbit populations obtained by members of the Natural History Survey staff give good evidence that this animal is subject to cyclic fluctuations in Illinois. In the northern tier of states, the cottontail cycle has been found to correspond rather closely to that of the prairie chicken. It may be noted that cottontails increased rapidly in central and southern Illinois during the 1936-1938 period, but they did not reach a peak until 1939, the year following the peak of prairie chicken populations, when exceptionally large numbers of rabbits were evident. Thereafter, rabbits declined steadily and were generally scarce in the central and southern parts of the state in 1941 and 1942. The lowest count of male prairie chickens on the Jasper County area was in the spring of 1942. The re-

sults of the 1942 booming ground census are subject to some doubt, however, since prevailing windy weather during the 2 days when the count was made may have prevented the appearance of some males on the booming grounds. Time and travel restrictions in 1942 prevented later rechecking.

Although from the present study there is little evidence of the sustained rises and declines which seem to characterize the grouse cycle in the northern tier of states and Canada, the population records so far obtained suggest the possibility that southeastern Illinois prairie chickens are subject to some degree of cyclic fluctuation.

Reports of game technicians at a seminar on prairie chickens held at Urbana, Ill., in December, 1940, showed that prairie chickens had increased during the previous 4 or 5 years in nearly all central states from Kansas to Indiana. A plan agreed to at this meeting to pool population data gathered over a period of years by game investigators working in several midwestern states offers a means of eventually reaching conclusions as to the behavior of populations of greater prairie chickens in the southern part of their range.

MORTALITY CAUSES

The causes of prairie chicken mortality in Illinois, as indicated by field studies, include predators, pathological factors, accidents and illegal hunting, as well as certain hazards that are peculiar to the infant and juvenile periods.

Juvenile Hazards

To determine the amount of annual reproduction of partridges, Middleton (1935) in England used the ratio of young to adult birds found by a midsummer census taken over a series of years. This method was used to some extent with greater prairie chickens in southeastern Illinois. The census for the third week in July, 1935, on the Jasper County area showed 80 adults and 110 young, or 1.38 young per adult. A similar census in 1936 showed 95 adults and 70 young, or 0.74 young per adult. These results indicate a significant variation in the number of young birds present in midsummer, a variation due apparently to a number of influences. Weather during the breeding and hatching period may influence reproduction and the survival of young, but this situation is a complex one in which the various phases of the reproductive cycle must be considered, as well as the possible effect of weather on cover, food and parasite dissemination. We have insufficient data for conclusions.

It is evident that mortality among very young birds may be high. For example, in the summers of 1935 and 1936, the average number of eggs was 12.3 in 12 full clutches that underwent normal incubation. The average size of broods at hatching was 11.4 young. However, at an average age of about 5 weeks, 32 broods in which the total number of young could be determined with reasonable accuracy showed only 6.2 young per brood, indicating an average loss for the two seasons of approximately 46 per cent during the infant and early juvenile periods. It is probable that the heaviest losses occurred when the young were only a few hours or days old.

Although, because of small samples, this figure can be regarded as only approximate, it assumes a heavy loss of weak and inexperienced young similar to that reported in certain other gallinaceous birds. It is of interest to note that Lehmann (1939), working in eastern Texas in the summer of 1937, found a loss of about 50 per cent of young Attwater's prairie chickens, *Tympanuchus cupido attwateri* Bendire, during the 4 weeks after hatching.

Actual records of the fate of young prairie chickens are extremely difficult to obtain. Occasionally one or more eggs fail to hatch until after the brood has left the nest. A few young die in the nest from weakness or trampling; any weak or subnormal birds undoubtedly soon fall behind when the female leads the brood away from the nest. Exposure to the direct rays of the sun or to chilling temperatures, resulting from flushing of the female, may be fatal to very young birds. Enemies, accidents, straying and various other hazards add to the toll of the young; for example, a 2- or 3-day old prairie chicken found with its skull broken in by a large, but unidentified, bird. As the young prairie chickens become stronger

and more experienced, the losses among these birds drop sharply.

Predators

It has become evident in recent years, as a result of numerous studies on the relation of predatory species to game species, that predation has a less important role in the control of game populations than was formerly supposed. Game populations often fluctuate widely, apparently to a large extent without reference to the presence or absence of enemies.

Although there is variation in feeding habits and food preferences, predatory birds and mammals tend strongly to take what is abundant and easy to obtain. This tendency is reflected by the fact that in Illinois during most of the year rodents bear the brunt of the feeding activities of the great majority of the larger predatory species.

None of the small furbearers appears to be an important predator on young or adult prairie chickens in the gray soil prairie region of the state. The predatory species most conspicuous by reason of numbers or of apparent ability to inflict losses on prairie chickens in this region are the Cooper's hawk, the marsh hawk, the horned owl and the red fox.

Cooper's Hawk.—The Cooper's hawk, *Accipiter cooperi* (Bonaparte), feeds primarily on birds and is the species most often guilty of taking game birds and poultry in Illinois. McAtee (1935) reports that game birds were found in 31 of the 261 stomachs of Cooper's hawks examined by the U. S. Bureau of Biological Survey. Stoddard (1931) regards this hawk as probably the worst natural enemy of the bobwhite in the southeastern part of the United States.

This "blue darter" is not especially common as a nesting species in the prairie districts of southeastern Illinois. Where it occurs in this region during the spring and summer, its depredations on prairie chickens seem to be confined chiefly to the immature birds. If Cooper's hawks are present in any numbers on refuges or management areas, control measures will probably be called for in the case of this species.

If control of Cooper's hawk is undertaken, it should be with full knowledge of the appearance of this hawk, since it is a notably secretive species and is rarely bagged by hunters unfamiliar with its habits. Promiscuous shooting of hawks and owls is likely to do more harm than good, since the slower, more conspicuous species are usually those that feed chiefly on rodents. It should be remembered that rodents, especially ground squirrels and field-inhabiting rats, may be serious enemies of nests and young of game birds, as well as destroyers of farm crops. Most predatory birds can well be encouraged for their assistance in the control of these animals.

Marsh Hawk.—The marsh hawk, *Circus hudsonius* (Linnaeus), is a common summer resident throughout the gray soil prairie region of Illinois. Because, during the period of intensive field work in southeastern Illinois, marsh hawks hunted regularly over fields occupied by coveys of prairie chickens, special efforts were made to determine the extent to which these hawks preyed on the young chickens. Examination of many pellets in the field, observations on hunting marsh hawks, and studies of prey brought to the young hawks by the adults, did not give evidence of the killing of appreciable numbers of prairie chickens by these hawks.

Errington & Breckenridge (1936) report that young pheasants made up slightly more than 4 per cent of the total number of food items taken by marsh hawks in the Iowa pheasant range during the summer of 1935. That such predation does not have a serious effect on the pheasant crop is indicated by the report of Errington & Hamerstrom (1937) that, during their Iowa pheasant studies, broods of young pheasants in areas where marsh hawks were rare shrank in size at the same rate as did broods in areas hunted by marsh hawks.

Randall (1940) found that marsh hawks caused about 10 per cent of the total mortality of juvenile pheasants on a study area in Lehigh County, Pa., where both marsh hawks and pheasants were common. The loss amounted to 1.3 per cent of the population of young pheasants.

Grange (1941), reporting on the progress of a grouse investigation in central Wisconsin, tentatively concluded that "Marsh Hawks are probably a consistent but small factor in the mortality of young

grouse in our area." He pointed out that destruction of striped spermophiles and other potential enemies of prairie grouse by marsh hawks may counterbalance the harm done in preying on the young birds.

Leigh (1939) summarizes his records of the food brought to a family of young marsh hawks under observation in the Jasper County study area as follows:

> During the period of observation, young (unidentified) song birds, immature rabbits and meadow mice (*Microtus*) constituted the major portion of the bill-of-fare for the young raptors. Recognizable bird remains included three young Bob-white and two young Upland Plovers (*Bartramia longicauda*). As far as could be determined from feathers, pellets, and other fragments, no Prairie Chickens were brought into the young during the observation period.

Although the marsh hawk may occasionally take a young prairie chicken, our observations on the summer feeding habits of this hawk in southeastern Illinois provide no evidence that it can capture prey as large as an adult prairie chicken, unless the chicken is crippled or otherwise incapacitated.

If control of the marsh hawk is indicated on game management areas or refuges for the benefit of game birds, it should be restricted to individuals that are known to be doing harm. McAtee (1935) sums up the economic status of the marsh hawk on the basis of 601 stomachs examined by the U. S. Bureau of Biological Survey as follows:

> Probably the insect food of the marsh hawk may be balanced against that portion composed of the moderately beneficial snakes and frogs. The remainder of its subsistence is about equally divided between birds and mammals, the indication being that more harm than good is done in the destruction of the former and that the reverse is true in the case of the latter. The economic tendencies of the marsh hawk seem to be about evenly balanced, and the decision as to whether it should be interfered with should be based on local experience—but this should be actual experience or observation, not prejudice.

Buteo Hawks.—These large, soaring hawks, or "mouse hawks," *Buteo* spp., are relatively unimportant as enemies of prairie chickens.

Although the red-tailed hawk may now and then manage to capture full grown prairie chickens on the ground, it is too slow to overtake these birds when they are in flight. The red-tail feeds to some extent on such potential enemies of game birds as ground squirrels, barn rats, crows and bull snakes, thereby probably compensating for occasional destruction of game. The bulk of its food consists of rodents.

Red-shouldered hawks and rough-legged hawks rarely molest healthy game birds and may be useful on game areas because they tend to keep rodent populations in check and occasionally take weak or diseased game animals or birds that might serve as sources of infection.

Great Horned Owl.—The great horned owl, *Bubo virginianus virginianus* (Gmelin), a large and powerful predator, is usually regarded as a serious enemy of small game. Exhaustive studies by Errington, Hamerstrom & Hamerstrom (1940) on food habits of this owl in Iowa and Wisconsin show that rabbits and hares are the staple items in the diet of this predator. It regularly eats smaller rodents, chiefly mice and rats, according to these authors. Passerine birds, poultry and game birds make up only a minor part of the total diet. Instances of conspicuous local predation on game birds are usually associated with environments overpopulated by the game species.

In southern Illinois, horned owls inhabit chiefly the more heavily wooded sections where prairie chickens are not plentiful. Consequently, predation seems for the most part to be confined to areas where woodland and prairie are well interspersed. Even there our evidence against this owl does not indicate serious predation on game birds.

Stoddard (1931) regards the great horned owl as beneficial on quail preserves in the southeastern United States because of the assistance it gives in keeping skunks, opossums, cotton rats and other enemies of the bobwhite within bounds.

On refuges or game management areas, particularly in the northern part of Illinois, elimination of individual horned owls may in some cases be necessary to protect concentrations of game birds, but a systematic campaign to eradicate these predators from prairie chicken refuges is not recommended.

Other Owls.—Although the northern

barred owl, *Strix varia varia* Barton, approaches the horned owl in size, it feeds to a greater extent on mice and is less prone to take poultry or game birds. This owl is generally more common than the horned owl in the southern Illinois prairie chicken range. It sometimes hunts in the daytime and is the large owl most frequently shot by hunters. On the basis of intensive food studies, as well as field observations in Illinois, killing of these birds is not to be recommended except in the case of individuals that may form the habit of taking poultry or game birds.

Throughout the prairie region of Illinois, the short-eared owl, *Asio flammeus flammeus* (Pontoppidan), is encountered by hunters probably more often than any similar bird because of its habit of resting during the daytime, singly or in small groups, in weedy areas or stubble fields. Short-eared owls are attracted to fields in which mice are abundant, where they sometimes hunt by day. Their pellets usually contain little besides mouse fur and bones. These birds rarely nest as far south as south central Illinois; throughout the state they occur mainly as winter residents. Smaller than northern barred owls, they are not known to take game birds larger than a bobwhite or a Hungarian partridge, and these only rarely. The short-eared owl, the barn owl, *Tyto alba pratincola* (Bonaparte), and the long-eared owl, *Asio wilsonianus* (Lesson), are highly beneficial to the farmer and should be fully protected.

Red Fox.—In recent years, the population trend of the red fox, *Vulpes fulva* (Desmarest), in the state has been generally upward. At present, red foxes can be classed as abundant throughout the prairie chicken range of southern Illinois. According to distribution studies made by Dr. Carl O. Mohr of the Illinois Natural History Survey, and based on trappers' records, the red fox population of the gray soil prairie region is somewhat higher than the average for the whole state.

Although no special study of fox food was attempted, field records obtained in southeastern Illinois during all seasons throughout a period of 7 years did not indicate that the red fox was particularly destructive to game birds in that region.

Errington's (1937) conclusion that pheasants, bobwhites and Hungarian partridges in Iowa are subject to a temporary increase in vulnerability to general predation at the beginning of the mating and breeding season is in agreement with our observations on prairie chickens. Nevertheless, prairie chicken losses at this season did not reach serious proportions in the Illinois area studied.

Although some of the six instances of apparent desertion of nests listed in the section on nesting may possibly have been due to death of the female, it is of interest to note that no instance of killing or injury of a female directly on the nest by a predator was evident in the 39 nests under observation. Probably reduced emission of scent during the incubation period, which occurs in the prairie chicken and certain other gallinaceous birds, is in part responsible for the relative safety of the nesting female. However, this affords only partial protection, as indicated by the fact that killing of the female on the nest by house cats or other mammalian predators is reported in the bobwhite (Stoddard 1931) and the Hungarian partridge (Yeatter 1934).

Errington (1937) says of the fall, winter and early spring feeding of the red fox in Iowa:

> During fall and winter, the brunt of red fox feeding pressure is borne by mammals, notably mice and rabbits. Occasional passerine birds, ring-necked pheasants, and bobwhites are taken, and these and other species are freely eaten as carrion when carcasses are found in fields or along highways.
>
> Domestic chickens eaten are probably carrion for the most part at this season; many farmers habitually dispose of their dead chickens by throwing them on the manure spreader, and the carcasses thus become available to various creatures, including foxes. It often happens that foxes bite off and swallow only the heads or feet of carcasses of this sort that they may discover. With the coming of spring and the pupping season, mice and rabbits continue to be the main staple foods, but other forms receive more attention, apparently in proportion to their increased availability. Migratory sparrows, blackbirds, meadowlarks, etc., yield some toll; and ground squirrels are captured as they leave hibernation for the dangers of active life.

Examination of fragments and feathers around fox dens, of fox scats and of various "kills" of game birds found in the

field during the investigation gave relatively few indications of fox predation on prairie chickens among several hundred items of food. Nevertheless, experience may show that control of fox populations is desirable on refuges or game management areas where special efforts are being made to conserve and increase prairie chickens or other game birds. The comparative abundance of both chickens and foxes in southeastern Illinois, however, is good evidence that the fox does not constitute a serious menace to these birds in good chicken habitats.

Other Predators.—Evidence is mounting from various studies that ground squirrels may be important as destroyers of game bird nests as well as their young. Grange (1941), working in Wisconsin, reports several instances of capture and killing of very young domestic chickens by the 13-striped ground squirrel, *Citellus tridecemlineatus* (Mitchill). Near Urbana, Ill., in the summer of 1942, we found good evidence of the destruction of several pheasant nests by the Franklin's ground squirrel, *C. franklinii* (Sabine). Ground squirrels are much more common in the dark soil prairie districts than in the gray soil prairie and their control may present special problems on refuges in the northern part of the state.

Since the crow, *Corvus brachyrhynchos brachyrhynchos* Brehm, is known on occasions to be destructive to young prairie chickens as well as eggs, large numbers of this bird on refuges during the nesting season would normally be undesirable.

Pilot black snakes, common black snakes, bull snakes, and possibly certain other snakes, are potential predators on the young and eggs of prairie chickens, but, as these forms feed extensively on rodents, their control should not be undertaken unless they prove actually harmful on refuges. The pilot black snake, *Elaphe obsoleta obsoleta* (Say), whose food was investigated by Uhler, Cottam & Clarke (1939), is fairly common in Illinois, and the common black snake, *Coluber constrictor constrictor* (Linnaeus), which was found by Stoddard (1931) to rob quail nests in Georgia, is present in the prairies of southeastern Illinois. On the basis of the above studies, these forms might be expected to take some eggs or young of prairie chickens. The bull snake, *Pituophis sayi sayi* (Schlegel), which is known from studies conducted by the Illinois Natural History Survey to take the eggs or young of waterfowl on occasions, is not numerous on the prairie, but might possibly cause minor losses of eggs or young of prairie chickens in the vicinity of wooded areas.

Domestic cats and dogs have often been reported as causing loss of eggs and young of game birds. Although no instance of predation on prairie chickens by either cats or dogs was found in the present study, it is not unlikely that in southeastern Illinois both animals, particularly field-hunting cats, annually destroy a number of nests and young of prairie chickens.

Parasites and Diseases

Appraisal of the role of diseases and parasites in wildlife mortality is a difficult matter. Very weak animals often secrete themselves in thick cover where they are likely to be found, if at all, only some time after death has occurred; if partially disabled, they may be caught by predators and the evidence thus destroyed. Nevertheless, mounting evidence from field studies indicates that pathological factors may be responsible for greater losses of wildlife than has generally been supposed.

Since the prairie chicken is closely associated with domestic chickens and turkeys throughout its range in southeastern Illinois, the possible effect of poultry diseases and parasites on prairie chickens was considered an important part of the investigation. Gross (1930) reports that certain poultry parasites and blackhead, a disease fatal to domestic turkeys, were found in the prairie chicken in Wisconsin and in its close relative, the heath hen, *Tympanuchus cupido cupido* (Linnaeus), in Massachusetts.

During the Illinois investigation, a single prairie chicken showing the clinical symptoms of blackhead was found (Leigh 1940). This bird, an adult male, was extremely emaciated, and died soon after being captured.

Although field studies in 1935 and 1936 did not give evidence of serious losses from pathological causes among adult birds, the finding of some unmutilated

but partly decomposed carcasses of young birds during both years was considered as of possible significance from the standpoint of pathology. Previously, Leopold (1931) published a report of similar findings by an observer in Missouri, and Bennitt & Nagel (1937) quoted game wardens and other observers, also in Missouri, as finding dead young during the drought summer of 1934.

In a study of the parasites of Illinois prairie chickens, Leigh (1940) autopsied 14 young and 14 adult birds collected during field work in southeastern Illinois. Blood smears showed no indication of blood parasites. Smears of intestinal and caecal scrapings were negative for coccidia or other protozoa.

Internal parasites reported by Leigh included three species of tapeworms, two species of roundworms and one species of Acanthocephala. It is of interest to note that, although no tapeworms were found in the adult chickens, 10 of the 14 young birds were infested with tapeworms, which, in four cases, completely occluded the lumen of the small intestine for most of its length. Since the most intense infestations were by an apparently rare and hitherto undescribed species of tapeworm, there seems to be little relationship between parasitism and the presence of domestic poultry.

With respect to the possible effect of these parasites on the survival of juvenile birds, Leigh states:

> Although it cannot be definitely stated at this time that the high incidence and heavy infestations with cestodes of a genus known to be pathogenic for other gallinaceous birds constitute a serious mortality factor in young prairie chickens, it is reasonable to think that the minimum effect of such intense parasitism in birds 4 to 8 weeks old would be a reduction in vitality which would open the way to secondary infections and render the birds more susceptible to predation or unfavorable environmental factors. Finding no cestodes in adult hosts would seem to indicate that the prairie chicken is susceptible to the new species of *Raillietina* during only the first few weeks of life.

Accidents

Accidents, chiefly those in which the birds strike wires or other objects while in flight, not infrequently cause the death or crippling of prairie chickens. The extent of such accidents, while probably greater than generally supposed, cannot be accurately determined because of the work of predators or scavengers that usually dispose of victims in a short time.

Illegal Hunting

Although the closed season in general affords fair protection, illegal hunting takes a moderate but steady toll of prairie chickens in some parts of the Illinois range. Unfortunately, in areas where prairie chickens are numerous, public sentiment tends to be somewhat indifferent in regard to protection. Probably the most serious consequences of illegal hunting come through the loss of occasional birds from small, isolated colonies in the northern part of the state.

Mortality and Populations

The foregoing discussion of mortality factors will serve to emphasize the fact that, given proper environment, the prairie chicken has a reproductive rate sufficiently high to cope with predators, disease, accidents and other hazards. As previously pointed out, the welfare of this species in Illinois is dependent chiefly on suitable environment during the nesting period and while the birds are very young. It is evident that prairie chickens can under certain farming systems maintain themselves for long periods in close contact with agriculture.

Hunting, under the short open season prevailing in Illinois a few years ago, added to other mortality factors, served to depress prairie chicken populations and undoubtedly constituted a limiting factor in marginal range; nevertheless, it seems apparent that the gun was not the primary cause of elimination of the prairie chicken from most of its range in dark soil prairie counties of the state.

FOOD HABITS

Field studies indicate that prairie chickens, particularly the young, feed to some extent throughout the day, but the main feeding periods are for about 2 hours in the morning, beginning a short time after

Table 2.—Foods found in stomachs of 10 adult prairie chickens collected in southeastern Illinois in late June, July and August, 1936 and 1937.

Food	Number of Stomachs in which Food Item Occurred	Per Cent of Food Items by Volume	Totals
VEGETABLE FOOD			
Wild Seeds			
Buttonweed, *Diodia teres* Walter	8	21.2	
Giant ragweed, *Ambrosia trifida* Linnaeus	3	9.0	
Partridge pea, *Cassia Chamaecrista* Linnaeus	2	4.6	
Pennsylvania persicaria, *Polygonum pennsylvanicum* Linnaeus	2	0.8	
Wild mustard, *Brassica* sp.	1	trace	
Black bindweed, *Polygonum Convolvulus* Linnaeus	1	trace	
Yellow foxtail, *Setaria glauca* (Linnaeus) Beauvois	1	trace	
Total wild seeds	.....	.....	*35.6*
Fruit			
Dewberry, *Rubus villosus* Aiton	8	24.5	
Panicle dogwood, *Cornus paniculata* L'Héritier de Brutelle	4	3.4	
Wild black cherry, *Prunus serotina* Ehrhart	2	2.0	
Prairie rose, *Rosa setigera* Michaux	1	1.4	
Hawthorn, *Crataegus* sp.	1	trace	
Total fruit	.....	.....	*31.3*
Browse			
Flowering spurge, *Euphorbia corollata* Linnaeus	2	9.3	
Goldenrod, heads and leaves, *Solidago* sp.	3	7.5	
Unidentified leaves	1	0.9	
Total browse	.....	.....	*17.7*
Grain			
Wheat, *Triticum sativum* Lamarck	1	4.7	
Total grain	.....	.....	*4.7*
Mast			
Acorns	1	0.5	
Total mast	.....	.....	*0.5*
Vegetable debris	3	1.2	*1.2*
TOTAL VEGETABLE FOOD	.....	.....	91.0
ANIMAL FOOD			
Insects			
Short-horned grasshoppers, Acrididae	6	4.8	
Ground beetles, Carabidae	6	2.2	
Leaf beetles, Chrysomelidae	3	0.9	
Snout beetles, Curculionidae	1	0.5	
Beetles, unidentified	1	0.4	
Cutworms and army worms, Noctuidae	1	0.1	
Insect pupae	2	0.1	
Total insects	.....	.....	*9.0*
TOTAL ANIMAL FOOD	.....	.....	9.0

Table 3.—Foods found in stomachs of 14 young prairie chickens collected in southeastern Illinois in late June, July and August, 1936 and 1937.

Food	Number of Stomachs in which Food Item Occurred	Per Cent of Food Items by Volume	Totals
VEGETABLE FOOD			
Fruit			
Dewberry, *Rubus villosus* Aiton	7	13.2	
Wild black cherry pits, *Prunus serotina* Ehrhart	4	6.1	
Panicle dogwood, *Cornus paniculata* L'Héritier de Brutelle	4	2.8	
Prairie rose, *Rosa setigera* Michaux	1	0.4	
Ground cherry seeds and pulp, *Physalis* sp.	1	0.1	
Hawthorn, *Crataegus* sp.	1	trace	
Total fruit	.....	.....	*22.6*
Grain			
Wheat, *Triticum sativum* Lamarck	6	17.3	
Corn, *Zea mays* Linnaeus	1	1.6	
Oats, *Avena sativa* Linnaeus	1	trace	
Total grain	.....	.....	*18.9*
Wild Seeds			
Buttonweed, *Diodia teres* Walter	9	11.8	
Bull grass, *Paspalum* sp.	1	0.2	
Hairy panic grass, *Panicum huachucae* Ashe	2	trace	
Sheep sorrel, *Rumex Acetosella* Linnaeus	1	trace	
Knotweed, *Polygonum aviculare* Linnaeus	1	trace	
Yellow foxtail, *Setaria glauca* (Linnaeus) Beauvois	1	trace	
Total wild seeds	.....	.....	*12.0*
Browse			
Unidentified leaves	5	3.5	
Goldenrod heads and leaves, *Solidago* sp.	3	2.9	
Total browse	.....	.....	*6.4*
Vegetable debris	2	0.6	*0.6*
TOTAL VEGETABLE FOOD	.....	.....	60.5
ANIMAL FOOD			
Insects			
Short-horned grasshoppers, Acrididae	12	17.4	
Long-horned grasshoppers, Tettigoniidae	5	4.2	
Ground beetles, Carabidae	7	3.3	
Scarab beetles, Scarabaeidae	2	3.1	
Leaf beetles, Chrysomelidae	8	3.0	
Stink bugs, Pentatomidae	4	1.3	
Long-horned beetles, Cerambycidae	1	1.3	
Snout beetles, Curculionidae	7	1.7	
Lady beetles, Coccinellidae	2	0.8	
Robber flies, Asilidae	3	0.7	
Ants, Formicidae	5	0.6	
Cutworms and army worms, Noctuidae	3	0.4	
Tiger beetles, Cicindelidae	2	0.4	
Grub parasites, Tiphiidae	4	0.3	
Crickets, Gryllidae	1	0.1	
Soft-winged flower beetles, Melyridae	1	trace	
Leafhoppers, Cicadellidae	2	trace	
Total insects	.....	.....	*38.6*
Arachnids	2	0.9	*0.9*
TOTAL ANIMAL FOOD	.....	.....	39.5

sunrise, and in the afternoon for an hour or more before sundown. In summer the adults and young have frequently been observed dusting along field margins early on clear mornings previous to feeding. On dark, rainy days, the females and young are likely to be found sitting quietly along hedges well through the usual morning feeding period.

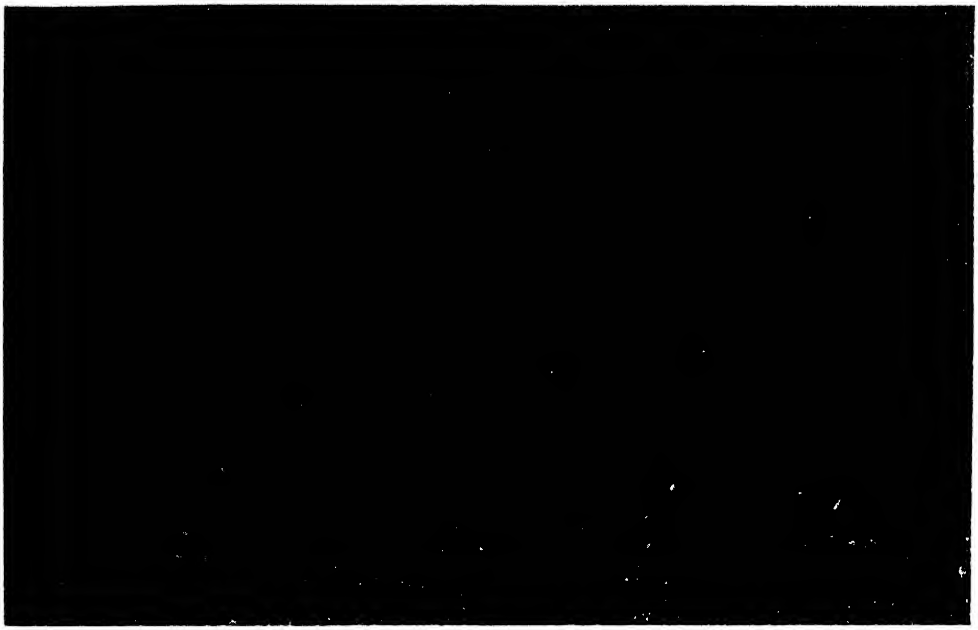

Fig. 13.—A cornfield, right, in which numerous prairie chickens fed in the winter of 1938-39, and nearby grassland used as cover.

In the spring, the males appear to feed little until after the morning booming period.

Several workers have investigated the food of the prairie chicken in the Middle West. Judd (1905) analyzed the stomachs of 71 chickens collected in the Mississippi valley during all months except July. The food consisted of approximately 46 per cent seeds and grain, 25 per cent browse, including leaves, flowers and buds, 14 per cent animal matter, chiefly grasshoppers, 12 per cent fruit and about 3 per cent miscellaneous vegetable matter, mostly acorns.

About 31 per cent of the annual diet was grain, over half of which was corn. Nearly 15 per cent consisted of weed seeds, over half of which belonged to the smartweed family. The fruits eaten were chiefly rose hips. Insects made up about one-third of the food of chickens collected during the period of May to October, inclusive.

Gross (Bent 1932) reported that 17 prairie chickens, collected mostly during the fall in Wisconsin, had eaten about 72 per cent vegetable matter and 28 per cent animal matter. Although more than 160 kinds of animal matter and vegetable matter were found in the diet, it was evident that a dozen items made up nearly 90 per cent of the food. Arranged in the order of percentages of all the food eaten, the 12 leading items were short-horned grasshoppers 26.7, ragweed 11.0, oats 10.8, clover 7.7, black bindweed 6.2, acorns 4.5, greenbrier 3.6, dogwood 3.5, crickets 3.3, buckwheat 3.1, bramble 3.1 and blueberries 2.4.

Schmidt (1936) observed during a study of the winter feeding habits of Wisconsin prairie chickens that buds, especially of birch, hazel and aspen, formed a large part of the diet of males in the northern counties of the state when temperatures were above zero, but that corn or other grain and weed seeds were taken regularly when the temperatures were below zero. He found that, in the southern Wisconsin counties, resident birds and

migrant females appeared to feed on grain, weed seeds and buds through the winter.

Hamerstrom's (1941) field studies and experimental feeding of prairie chickens in confinement showed that Wisconsin birds eat grains, weed seeds, browse and greens in autumn and winter, but throw greater emphasis on the value of cultivated grains, including corn, buckwheat, barley, oats and rye, as winter food.

Field observations show that waste soybeans, waste corn, fig. 13, and weed seeds form an important part of the winter diet of the prairie chicken in southeastern Illinois. As a rule, prairie chickens do not eat shocked corn except during periods of deep snow. Although grain sorghums are not grown extensively in this region, during severe weather the birds readily eat sorghum in shocks, if it is available. They eat available weed seeds, as well as grains, throughout the winter and early spring. The crop of a recently killed female found on March 29, 1937, was full of soybeans. Winter droppings almost invariably contain quantities of grass and other green material. Fruits of rose and wild grape, as well as other persistent fruits, are in the diet to some extent during the winter.

Apparently budding is less common in Illinois than in Wisconsin. Prairie chickens have been observed eating buds from as early as Nov. 9 to early April in southeastern Illinois; however, so far as our records go, budding is not a daily practice. Probably green leaves of grass and herbaceous plants partially supplant buds in the diet at this latitude, as suggested by Leopold's (1931) observations in Iowa. Cottonwood is the chief browse species, but buds of red maple, elm, apple and probably several other trees and shrubs are included to some extent.

Samples of the summer diet of prairie chickens are illustrated in tables 2 and 3, showing percentage by volume of various food items in crops and gizzards of 10 adult and 14 young birds taken in southeastern Illinois during late June, July and August of 1936 and 1937. As has been shown by food studies of other gallinaceous birds, it is probable that the food

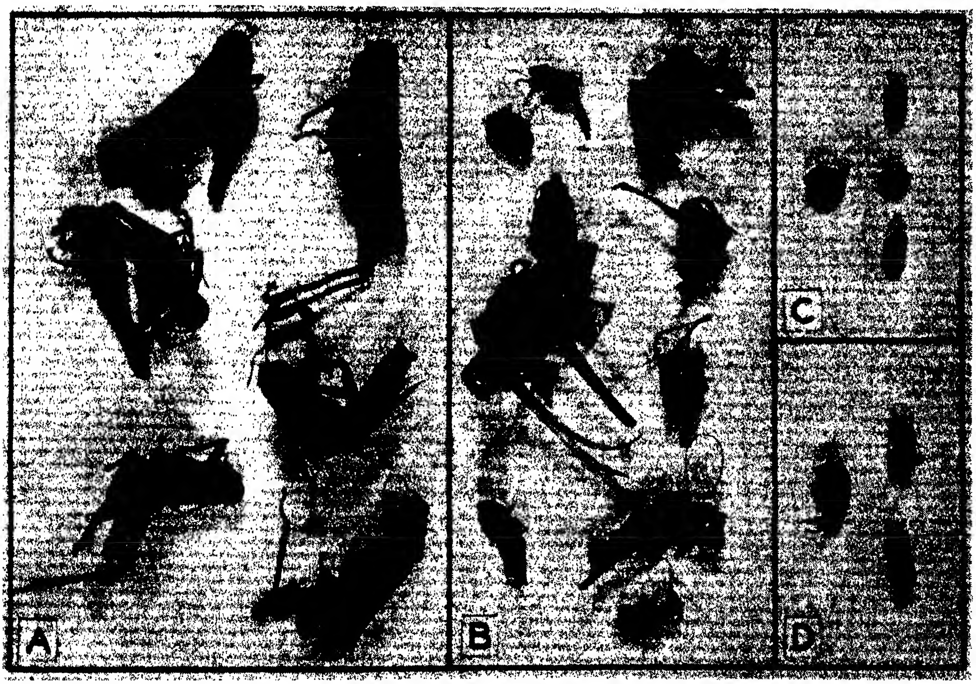

Fig. 14.—Animal matter found in the crop of a young prairie chicken (approximate age 10 weeks). *A.* Short-horned grasshoppers, *Melanoplus differentialis.* *B.* Short-horned and long-horned grasshoppers, including *Neoconocephalus robustus.* *C.* Leaf-feeding beetles, *Calligrapha similis* and *Cryptocephalus venustus.* *D.* Imbricated snout beetles, *Epicaerus imbricatus.*

of very young prairie chickens consists almost entirely of animal matter, chiefly insects. During the period of growth, the diet gradually changes to seeds, succulent vegetable material, fruits and insects characteristic of the summer diet of the adult. The stomach contents of the 14 young birds mentioned above, which averaged 9 to 10 weeks in age, consisted of 60.5 per cent vegetable matter and 39.5 per cent animal matter. Animal matter found in the stomachs of two young prairie chickens is shown in figs. 14 and 15. The food of the 10 adults taken in the same period as the young birds consisted of 91.0 per cent vegetable matter and 9.0 per cent animal matter.

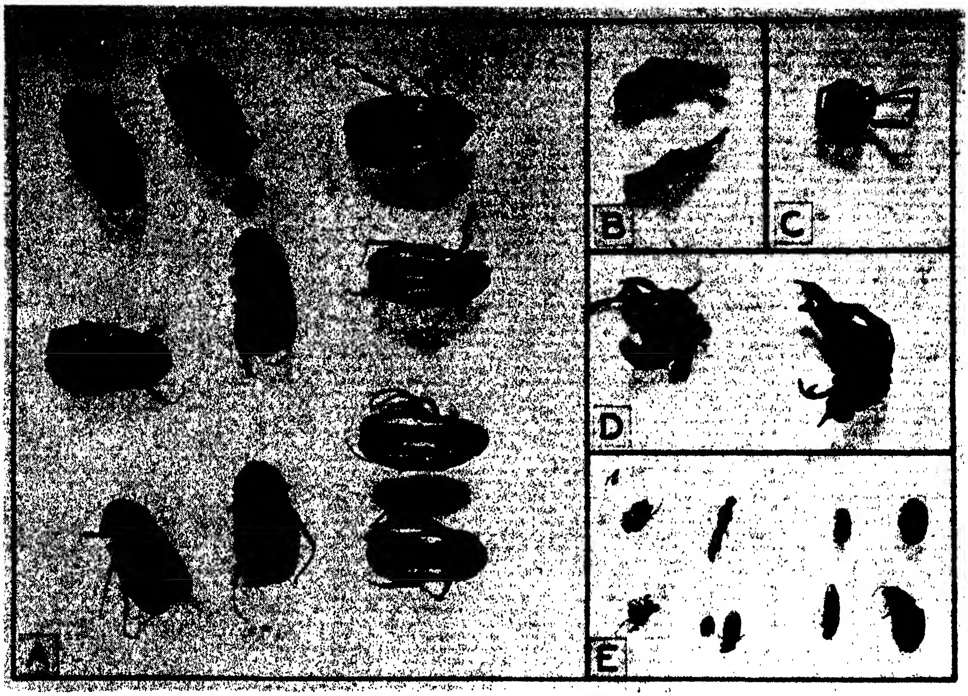

Fig. 15.—Animal matter found in the crop of a young prairie chicken (approximate age 8 weeks). *A.* June beetles, ***Phyllophaga*** spp. *B.* Long-horned and short-horned grasshoppers. *C.* Spider, Arachnida. *D.* Robber-flies, Asilidae. *E.* Miscellaneous beetles, bees and wasps.

In the adult stomachs analyzed, wild seeds (exclusive of fruit) and grains made up over 40 per cent of the contents, with weed seeds greatly predominating. Buttonweed seeds constituted over 21 per cent of the total contents.

In the stomachs of the young birds, grain made up a greater volume than wild seeds (exclusive of fruit), most of which were buttonweed seeds. The grain consisted chiefly of waste wheat kernels, many of which had started to sprout.

Wild fruits, including those of dewberry, panicle dogwood and wild black cherry, were prominent in the stomach material of both young and adults. Droppings examined in the field in July and early August contained quantities of dewberry or other *Rubus* seeds. Grange (1941) in Wisconsin reports that the occurrence of the trailing swamp blackberry, *Rubus hispidus* Linnaeus, apparently determined the distribution of sharp-tailed grouse and prairie chickens during a portion of the day and at times for periods of days in the summer of 1941.

The consumption by prairie chickens of large numbers of short-horned grasshoppers, figs. 14 and 15, must be regarded as a definite asset to agriculture. Other harmful kinds of insects eaten by the Illinois prairie chickens include snout beetles, scarab beetles, leaf beetles, cutworms and leafhoppers. Certain beneficial forms, including ground beetles, lady beetles and grub parasites, were eaten to some extent.

There is no evidence from field studies

that surface water for drinking is essential to either young or adult prairie chickens in Illinois. Probably dew meets part of the water requirements of these birds in summer, as Stoddard (1931) found in the case of bobwhites. In addition, the insect diet of the young birds and the fruit and green vegetation eaten by both young and old birds provide moisture when little free water is available. No evidence was found to indicate that prairie chickens made use of a small, intermittent stream in the Jasper County study area.

MANAGEMENT

Although definite limitations must be recognized in regard to management, it is evident that certain practical measures may be undertaken to insure the survival of prairie chickens in Illinois. That these birds can maintain themselves in good numbers in close contact with certain types of agriculture must be regarded as a highly encouraging sign. However, because of the possibility of future changes in agricultural practices, the present occurrence of prairie chickens over a fairly extensive district in southeastern Illinois must not be regarded with too much complacency.

Adequate legal protection and a well-balanced system of public-owned refuges, these refuges involving the use of submarginal prairie lands and serving several kinds of wildlife, are essential to a sound prairie chicken management program for Illinois. Experimental stocking of suitable areas with trapped birds offers a possible means of increasing the range of prairie chickens in the state. Certain favorable land use practices are indispensable to the increase, or even the survival, of these birds. Needless to say, the successful prosecution of a long-time program for the management and conservation of prairie chickens and other wildlife depends to a considerable extent on the degree of public interest and cooperation in such an undertaking.

Legal Protection

Inasmuch as hunting of prairie chickens in Illinois has been prohibited under the State Game Code since the close of the 1932 season, and the present study was begun only 3 years after closure went into effect, it has been possible to make certain observations relative to the effect of legal protection on prairie chicken populations. In the northern part of the state, where prairie chickens have been decreasing steadily for many years, increased protection has probably been of material assistance in the case of some of the larger remnant colonies. Nevertheless, the amount of prairie chicken range in northern Illinois has continued to decrease since 1933 with the disappearance of numerous small colonies. Obviously, in the northern counties the benefits received under a closed season have not been able to compensate for the unfavorable environment.

In the main parts of the southeastern Illinois prairie chicken range, there has been no evidence of a general rise of population densities attributable to the closed season. However, prairie chickens have gradually extended their range in this region throughout the period covered by the present study. Although there is some evidence that this range extension began as early as 1930, when large acreages of farm land were idle, it is notable that it did not cease in the middle 1930's, when much of the idle land was put back into cultivation. It seems probable that even the relatively moderate hunting pressure exerted during the 1912-1932 period was sufficient to eliminate prairie chickens from the marginal portions of their range in southeastern Illinois, and that reoccupation of these areas is now possible because of the survival of larger numbers of birds annually.

Since prairie chicken population densities vary widely in different parts of the range, it is almost impossible with the data at hand to arrive at a satisfactory estimate of the number of these birds now present in Illinois. It is virtually certain, however, that the total population is only a small fraction of the number of resident upland game hunters in the state. An average of 12 chickens for each of the approximately 2,650 square miles comprising the main ranges in northern and southeastern Illinois would mean a total of about 32,000 birds. Even if the total number were twice as large, it would represent less than 1 bird to 5 licensed Illinois hunters. Moreover, unlicensed hunters, consisting of landowners and tenants and

their children, all of whom can legally hunt without licenses on the farm land on which they reside, are probably almost as numerous as licensed hunters. Although the number of licensed hunters living in the northern half of the state is preponderantly greater than the number living in the southern half, many northern hunters go annually to southern Illinois for quail hunting. In view of the heavy demand for upland game hunting in the localities now inhabited by prairie chickens, it is evident that the gun is potentially an important factor in the conservation of prairie chickens in Illinois.

Legalization of prairie chicken hunting on a statewide basis at the present time would inevitably hasten the extermination of the remaining birds in the northern part of the state. Resumption of chicken hunting in southeastern Illinois, except under such rigid restrictions as to furnish little sport for the great majority of hunters, would presumably soon bring a halt to the present extension of range and in time would be expected again to eliminate these birds from the poorer portions of their present range.

Unless the number of prairie chickens in Illinois can be increased materially, the status of this species of game bird will probably remain doubtful. In spite of the fact that fair-sized prairie chicken populations now occur in four or five southeastern Illinois counties, and smaller numbers in several other counties, until all available range in this region is reoccupied, and until adequate steps are taken to safeguard the colonies in other parts of the state, full legal protection seems advisable.

Loss to farmers through consumption of unharvested corn by prairie chickens in winter has sometimes been advanced as a reason for reopening the prairie chicken season. Although it is true that a number of complaints of damage were heard from farmers in some localities following the increase of chickens in 1938, only minor damage has been reported since that time. There seems little likelihood of increase of prairie chicken population densities to high levels in Illinois except for occasional short periods. During periods of deep snow, which may temporarily increase consumption of grain by prairie chickens, trapping and transfer of birds to restock unoccupied regions offers a means of reducing damage in local areas.

Refuges

In northern Illinois, adequate refuge areas are the first necessity if the native prairie chickens of that region are to be preserved for the future. In Lee County, northern Illinois prairie chickens are making their last stand on approximately 50 square miles of sand prairie along the Green River. Much of this land consists of low dunes and is submarginal for agriculture. Bottomland areas, which are interspersed among the sand lands, are relatively fertile and are farmed or pastured intensively. Some of the pastured areas contain ponds or marshes and are leased for waterfowl shooting.

A 1,400-acre area has recently been purchased in Lee County as part of the Federal Aid in Wildlife Restoration Act program to serve as an upland game, furbearer and waterfowl refuge. This area, administered by the State Department of Conservation, is a forward step toward safeguarding the remnant prairie chicken population, although it is too small for an ideal chicken refuge. An area of 25 square miles probably represents the minimum that would serve as an adequate sanctuary for prairie chickens in this region.

The relatively high cost of bottomland soil is recognized as a serious obstacle to the acquisition of an adequate refuge area in the northern Illinois prairie chicken range. Careful blocking to include chiefly light sandy land would reduce the cost of acquisition. Nevertheless, inclusion of marsh areas and ponds would greatly increase the usefulness of such a refuge. These bottomlands furnish important habitats for prairie chickens, furbearers and other species of wildlife. They are among the few places where waterfowl now nest within the state. A well-managed refuge area of adequate size, consisting of perhaps 80 per cent upland sandy areas and 20 per cent marsh would be an important contribution to the conservation of wildlife, including a number of species that are now rare as residents or nesting forms within the state, for example, mallards, pintails, blue-winged teals, king rails, upland plovers and badgers, in addition to prairie chickens. It should incidentally

serve also as a sanctuary for prairie flowers and herbaceous plants, many of which are now rare in the state.

This area would, perhaps, eventually develop forest cover if withdrawn entirely from farming and grazing. Its usefulness as a wildlife sanctuary would depend on keeping a large part of it in open grassland. To accomplish this might require a special program similar to one outlined by Grange (1942) in Wisconsin, including perhaps controlled grazing, or farming on some of the better portions, and also controlled burning practices.

Since prairie chickens on the area would undoubtedly feed in winter on nearby farmed areas, an extensive system of food patches probably would not be strictly necessary, but, in case farming is adopted in the more fertile areas to maintain open land, some of the grain crops, especially corn, should be left standing to furnish winter food for wildlife.

From the standpoint of prairie chicken management, the chief native vegetation required would be species for budding; cottonwood, a favorite species in southern Illinois, would seem suitable for planting in small numbers in the northern Illinois range. A few aspen, wild cherry, panicle dogwood and hazel plantings might also be made if these species are absent. Development of widely scattered bramble growth, preferably dewberries, would provide summer food, as well as improve nesting areas.

Leasing Land for Refuges

Although solid blocks or closely grouped tracts of land are probably the most satisfactory from the standpoint of administration of public-owned refuge areas, good prairie chicken management practices do not require that refuge areas be contiguous, provided proper distribution of smaller refuge areas can be obtained. For example, certain sand prairie townships in northern Illinois which now have a few prairie chickens might be converted into good chicken range by leasing, and converting to refuges for a term of years, 25 per cent of the total land in the form of 20-acre, 40-acre or larger tracts of the poorer farm soil throughout each township. Except when control of woody vegetation is necessary on these areas, no grazing should be permitted and adequate protection from fire would be necessary.

Farming Practices

That prairie chickens are still making a strong stand in the redtop producing area of Illinois demonstrates that these birds are not necessarily eliminated by agriculture and suggests that the farming practices followed in this area may serve as a guide in making management recommendations.

The present general characteristics of the southeastern Illinois prairie chicken range may be summarized by stating that this range consists principally of prairie soils of relatively low fertility in mixed farming areas where annually 6 to 8 per cent of the total farm land is idle and about 15 to more than 25 per cent is in redtop. As suggested previously, these areas present favorable conditions for prairie chickens because redtop as well as idle fields produce cover and nesting places quite early in the spring, and the redtop is harvested relatively late, allowing most of the young birds to get on the wing before the cover is removed, fig. 16. The densest populations of prairie chickens occur in localities of relatively high redtop acreages, and, as a rule, the greater the amount of redtop harvested for seed, rather than hay, the better the range.

Since about half of the acreage of idle land in southeastern Illinois has developed sufficient grass to furnish nesting cover, it may be said that grass type cover occupies from approximately 20 to more than 30 per cent of the total farm land in the various localities occupied by prairie chickens. Presumably similar acreages of grassland and similar farming practices would create prairie chicken range anywhere they might be applied on the Illinois prairie. Undoubtedly the cover requirements may under certain conditions be met by considerably smaller acreages of grassland than those given above, as indicated by Bennitt's (1939) studies in Missouri, but because of the many factors involved no conclusions can be drawn here as to minimum cover requirements.

Since the redtop producing area will probably remain the chief potential range of prairie chickens in the state, and must be considered as very important in any

management program involving these birds, the future of the redtop industry is of special interest to wildlife conservationists.

As Burlison, Stewart, Ross & Whalin (1934) point out, the concentration of redtop seed production in southeastern Illinois is due to a combination of factors that favor the continuation there of the present type of farming. However, these authors warn that, because of overproduction of seed and declining soil fertility under present farming practices, a reduction of the average acreage of redtop on farms now producing this crop is in prospect. Increased grazing of redtop fields by livestock is mentioned as a probable part of such readjustment.

As far as can now be foreseen, although conditions will continue to favor the survival of prairie chickens in southeastern Illinois, reduction of the average acreage of redtop grown on individual farms will probably result in lower population densities than occur at present. Increased grazing will also tend to reduce the amount of habitable range. Nevertheless, the changes forecast by the study mentioned above will serve to put the redtop business on a stable, though reduced, basis and they probably will not in themselves eliminate prairie chickens from any large part of the prairie soils these birds now occupy.

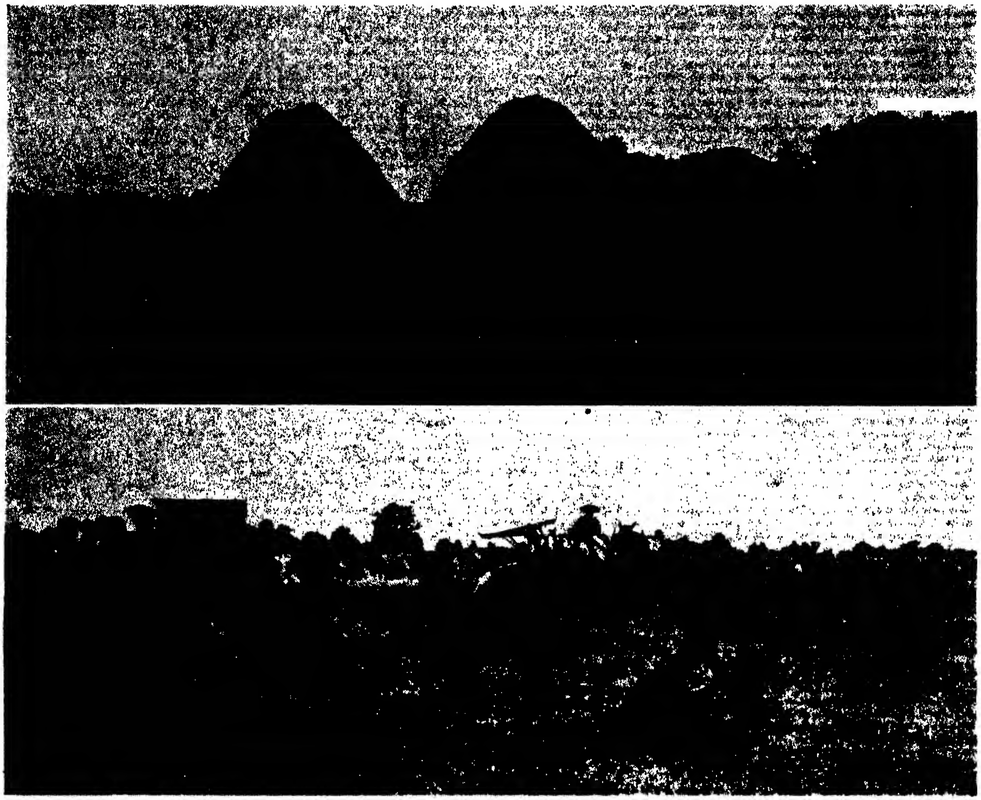

Fig. 16.—Harvesting redtop. Redtop grown for seed may be cut with a mowing machine and stacked (above) or with a binder and shocked (below). The latter method of harvest provides better late summer and fall cover for prairie chickens because of the taller stubble. (Photograph by courtesy of the Department of Agronomy, University of Illinois College of Agriculture.)

Even though the general trend of southeastern Illinois agricultural practices is slightly unfavorable to prairie chickens, individual landowners can assist in maintaining the populations at or near their present levels if they will practice moderate grazing of pastures, avoid burning of idle fields in the spring months and refrain, whenever possible, from disturb-

ing strips of idle grassland in which prairie chickens are known to be nesting.

In the dark soil counties of Illinois, prior to World War II, a trend was evident toward greater use of grass crops for hay, pasture and soil conservation. This trend, now interrupted by the necessity for greater grain production, may be resumed after the war.

Although it is unlikely that future agricultural developments will be of a nature to encourage the return of prairie chickens to large areas of intensively farmed dark soil prairie, it is possible that local conditions will permit the re-establishment of small populations of these birds in certain places. In some cases, small colonies of prairie chickens have persisted for many years in the dark prairie around grazed marshes, large pastures or other accidentally preserved areas of favorable range. It is our conclusion that only slight changes, consistent with sound farm management, would be necessary to create favorable environment for prairie chickens on many dark soil prairie farms. Controlled grazing, use of sweet clover as pasture during the spring and early summer, use of June clover, lespedeza and alsike as hay or seed crops, growing of mixed clover and timothy for hay, and reduction of the acreage of land annually plowed for spring crops, are indicated by field observations to be favorable to prairie chickens in the dark soil counties.

Observations made in southeastern Illinois indicate that the practice of supplying strips of undisturbed grassland bordering ditch banks and cultivated fields is a possible method of supplementing the present nesting cover in dark soil counties, but this method must be tried experimentally before conclusions can be reached as to its effectiveness.

Predator Control

The presence of normal predator populations along with relatively high populations of prairie chickens on southeastern Illinois farm lands gives a good indication that widespread predator control would be unnecessary or unprofitable in prairie chicken management. On refuges or management areas, the conditions actually existing on the ground should be the guide to predator control activities.

Large numbers of crows on refuges might cause undue loss of nests or young of prairie chickens. Cooper's hawks, if at all numerous, would be undesirable during the nesting season. On the other hand, the great majority of species of hawks and owls, as well as predatory mammals, can well be left undisturbed because of their activity in controlling ground squirrels and other rodents. Feral cats and dogs have no place on game preserves. Cats especially may be serious enemies of young prairie chickens (Lehmann 1941).

Normal harvesting of an annual crop of the common furbearing animals might be expected to exercise sufficient control to keep these forms from becoming overabundant and unduly destructive. As previously pointed out, evidence is lacking that foxes in moderate numbers exert any appreciable effect on prairie chicken populations. However, if it becomes evident that any particular form of predator has increased abnormally and is destructive, special efforts to reduce the population of that form to normal may be necessary.

No general program of predator control involving the use of pole traps or other nonselective devices that may take a heavy toll of harmless or beneficial species (Wight 1931) can be recommended for refuge areas. Control should be restricted to individual predators or species for which there is evidence of activities actually harmful to game birds.

Trapping and Restocking

The fact that agricultural practices change periodically on the Illinois prairie in response to market demands, and to developments in soil, water conservation and other factors, makes it possible that limited areas from which prairie chickens have disappeared may now or at a later time be successfully restocked by releasing trapped birds. Other areas of potential restored or increased range include fair-sized tracts withdrawn from agriculture, such as those surrounding munition plants in prairie districts, and the sites of existing prairie chicken colonies where landowners are willing to practice special management measures for the benefit of these birds.

Successful transplantation of prairie chickens in local areas has been reported

Fig. 17.—Tip-top traps used in trapping prairie chickens in southeastern Illinois, Feb. 9, 1940. The traps are covered with vegetation to make them less conspicuous.

in certain midwestern states, notably Michigan. Selection of suitable sites and the release of adequate numbers of birds are probably the chief factors in the success of stocking attempts. Trapping operations carried on by the Illinois Natural History Survey show that, with favorable weather conditions, southeastern Illinois prairie chickens can be trapped in winter at reasonable cost. A survey of possible sites for releases and the stocking of some of the most favorable areas on an experimental basis can well be part of a sound prairie chicken management program in Illinois.

Tip-top traps have been used with some success for trapping prairie chickens in southeastern Illinois, figs. 17 and 18. Since scarcity of snow makes trapping unproductive, sufficient equipment would be necessary to trap intensively during the relatively short periods of deep snow that occur in that region. Experiments with various types of traps (Hamerstrom 1942)

Fig. 18.—Removing a prairie chicken from a tip-top trap in southeastern Illinois. Corn and soybeans have proved to be the most attractive baits in this area.

would undoubtedly result in improved methods of trapping in Illinois.

Public Interest

That prairie chickens were formerly numerous throughout the Illinois prairie is well known. It is less generally realized that in a few counties these birds are still fairly abundant and may be seen and heard each spring during their courtship performance, even from paved highways running through settled farming communities.

In view of the fact that the prairie chicken was an outstanding species of Illinois wildlife in early times, and one that played an important part in numerous chapters of our pioneer history, it is unfortunate that serious consideration was not given to it when the official state bird was chosen. It is a typical resident of the grasslands of the Middle West, while the colorful and sprightly cardinal, our present state bird, is a representative of the fauna of the southern United States. Unlike the cardinal, which has been chosen as the official bird of nearly a dozen states, the prairie chicken has been adopted by no other state.

Because of the present restricted distribution and comparative rareness of prairie chickens in Illinois, relatively few residents of the state have had an opportunity to observe these truly magnificent birds in the field. Fortunately, in recent years some excellent moving picture shots of Illinois prairie chickens have been made. These pictures, now available to the public, have already proved of material value in arousing interest in the welfare of prairie chickens in this state.

Public interest and cooperation are essential to the success of any program designed to conserve and increase the numbers of prairie chickens in Illinois.

SUMMARY

1. Prairie chickens were originally distributed over the grasslands of Illinois. During the early stages of agricultural development, they extended their range to the cleared woodland soils and increased in numbers, probably reaching their highest populations in the 1860's. Thereafter they declined sharply, chiefly as a result of the rapid expansion of agriculture, which about 1880 involved a larger acreage than at present.

2. The present range of prairie chickens in Illinois is approximately 9 per cent of the original range and includes about 50 square miles in Lee County, northern Illinois, 2,600 square miles in southeastern Illinois and a number of small isolated colonies, principally in the northern and south central counties. Much of the information contained in this report is the result of research carried on since 1935 in a study area, 2 by 2 miles square, in Jasper County, southeastern Illinois.

3. In northern Illinois, prairie chickens are in danger of extermination, but in southeastern Illinois these birds are at present maintaining themselves in fair numbers.

4. The chief areas occupied by Illinois prairie chickens are on prairie soils of low fertility where special farming practices and idle land are favorable to the preservation of these birds.

5. The southeastern Illinois prairie chicken range, the largest and most important in the state, is in a district where redtop grass is grown extensively. This grass provides favorable habitats throughout the year, but its principal benefit to prairie chickens is that it furnishes undisturbed grass cover during the nesting season and while the birds are very young.

6. In southeastern Illinois, the first evidence of sexual display in the male prairie chickens occurs on booming grounds in late January or early February. This display reaches a climax in late April and ends about mid June.

7. There is evidence of a time differential in the development of the sexual cycle among both male and female prairie chickens. This differential is evident in the males from a variation in the stage of development in pigmentation of throat and eye regions, as well as in sexual activity, among males on the same booming ground.

8. The differential sexual development of females is indicated by a time spread in the dates on which individuals lay their first eggs, and also by a considerable spread in dates of hatching, not all of which can be attributed to renestings. Field records show that hatching begins in early May, reaches a peak in the first half

of June and tapers off during the first half of July.

9. Only 1 of approximately 20 booming grounds under observation each spring was used continuously for as long as 7 years.

10. In southeastern Illinois, prairie chickens may begin to flock as early as mid August. Winter flocks commonly range from 12 to 75 birds.

11. Prairie chickens tend to congregate in certain local areas to spend the winter. Dispersal from the wintering grounds takes place in March.

12. Prairie chickens show a preference for grassy cover throughout the year.

13. The areas used for nesting in southeastern Illinois are (1) redtop fields, (2) idle fields, chiefly those that are entering the grassland stage of succession, (3) small tracts of waste grassland.

14. In the years covered by this report, and in the region most carefully studied, low ditch banks, an abandoned railroad bed and other small waste areas of bluegrass were found to be the most intensively used nesting sites.

15. The average size of 12 full clutches of prairie chicken eggs was 12.3.

16. Although concentrations of many nests in limited areas of nesting cover are reported as formerly occurring in Illinois, the highest density found during the present study was 1 nest per acre.

17. The chief causes of nesting losses in southeastern Illinois are (1) predators, (2) nest desertion by the female, (3) farming operations, (4) failure of eggs to hatch.

18. Nineteen, or 49 per cent, of 39 nests under observation were successful.

19. Ninety-three per cent of 148 eggs that underwent normal incubation hatched successfully.

20. Many of the nest losses in southeastern Illinois occur early in the nesting season. Such losses seem to be largely compensated for by renesting.

21. Although attempts to renest are occasionally begun in this region as late as mid July, there is no evidence that nests begun after the middle of June produce a significant number of young.

22. Fall censuses of the Jasper County study area, beginning in 1935 and ending in 1941, showed a variation in population densities of from 1 bird per 10 acres to 1 bird per 18 acres. The average was 1 bird per 14.3 acres.

23. Evidence as to whether prairie chickens are cyclic in southeastern Illinois is inconclusive.

24. The causes of prairie chicken mortality indicated by the present study include predators, pathological factors, accidents, illegal hunting and certain hazards that are peculiar to infant and juvenile periods.

25. Brood studies in the summers of 1935 and 1936 indicated an average loss of approximately 46 per cent of the young birds during the first 5 weeks after hatching.

26. Predator studies in southeastern Illinois failed to reveal serious pressure on prairie chickens by any particular predatory species.

27. There is some evidence of losses of young prairie chickens from pathological causes.

28. Illegal hunting appears to be a serious factor where it involves small isolated colonies.

29. Analysis of the stomach contents of 14 young birds, of an average age of 9 to 10 weeks, collected in June, July and August, 1936 and 1937, showed the following percentages by volume of foods eaten: animal matter, chiefly insects, 39.5 per cent; fruit 22.6 per cent; grain 18.9 per cent; wild seeds (exclusive of fruit) 12.0 per cent; browse 6.4 per cent; vegetable debris 0.6 per cent.

30. The volumetric percentages of various foods found in the stomachs of 10 adult birds, collected during June, July and August, 1936 and 1937, were as follows: wild seeds (exclusive of fruit) 35.6 per cent; fruit 31.3 per cent; browse 17.7 per cent; insects 9.0 per cent; grain 4.7 per cent; vegetable debris 1.2 per cent; acorns 0.5 per cent.

31. Grains, especially waste corn and soybeans, and weed seeds are an important part of the winter diet of prairie chickens in southeastern Illinois. These birds consume buds of trees and shrubs to some extent from late fall until April.

32. Prairie chicken management in Illinois involves (1) legal protection, (2) the establishment of refuges in certain areas, (3) farming practices that provide favorable habitats, (4) trapping and restocking of birds in favorable places, (5)

a public interested in the prairie chicken and its welfare.

33. The recent extension of prairie chicken range in southeastern Illinois seems to be due largely to the closed season in effect since the end of the 1932 hunting season.

34. The hunting season on prairie chickens in Illinois should not be reopened until (1) there has been a considerable increase in the total number of prairie chickens in the state and (2) strategically located remnant populations have been safeguarded through the establishment of permanent refuge areas.

35. Refuges are urgently needed in northern Illinois. Such refuges should involve submarginal prairie lands and should benefit several wildlife species in addition to prairie chickens.

36. Refuge management should insure keeping a large part of the refuge areas in grassland.

37. In southeastern Illinois, prairie chickens are well adapted to living in prairie farming districts where from 20 to 30 per cent of the total agricultural land is grass type cover that is not disturbed until July 1 or later. Presumably, similar grass acreages and farming practices would create fair to good prairie chicken range anywhere they might be applied on the Illinois prairie.

38. Other farming practices that favor prairie chickens are moderate grazing, prevention of burning of grassland areas and use of late-harvested hay crops such as June clover, lespedeza, or mixed grasses and legumes.

39. The present outlook for redtop culture in southeastern Illinois indicates that the size of the prairie chicken range will not be reduced materially but that population densities in certain localities may be somewhat lower.

40. In the best interests of prairie chickens and other desirable wildlife species, nonselective predator control programs should be avoided on refuge areas. If control is necessary, it should be confined to individuals or species that are known to be doing harm.

41. Trapping prairie chickens where the birds are most abundant and releasing them experimentally in favorable areas elsewhere in the state offers a possible means of increasing the present range.

42. Public interest and cooperation are essential to a successful prairie chicken management program.

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Preferential Rating of Duck Food Plants

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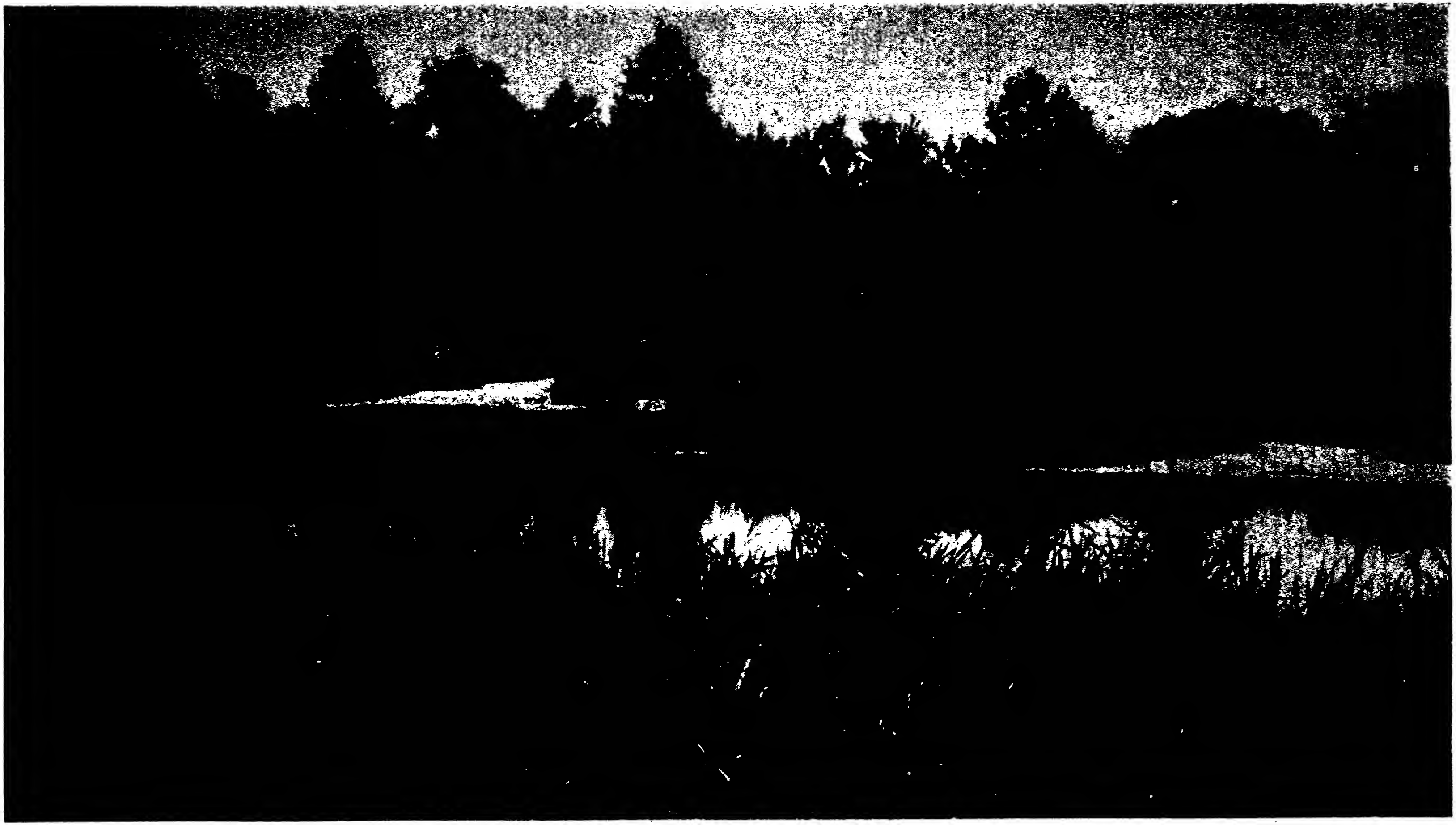

Rice cut-grass (*Leersia oryzoides*) growing in early fall along a tributary of the Illinois River. Research indicates that this moist-soil plant outranks all other uncultivated species as a source of food for migratory waterfowl in the Illinois River valley.

Preferential Rating of

Duck Food Plants

FRANK C. BELLROSE, JR.
HARRY G. ANDERSON

DURING the past decade, the amount of research on the food plants used by migratory waterfowl has increased notably. The basis for much of this research has been data obtained by the U. S. Biological Survey (succeeded by the U. S. Fish and Wildlife Service) through analyses of the contents of several thousand duck stomachs, collection of which was begun in 1901. These data have recently been summarized by Martin & Uhler (1939), who based their study on 7,998 stomachs, and by Cottam (1939).

Analyses of duck stomachs by the Biological Survey, other organizations and individuals has prompted wildlife investigators to attempt to ascertain the important duck food plants and their relative values in many regions of the United States. In all these studies, each plant species has been judged solely on its use, as determined by laboratory analyses of stomachs. While this method ascertains the important duck food plants, it does not reflect the relative values of these plants, for no consideration is given to the abundance of the plant species in the areas in which the stomachs have been collected. If in a certain area a plant species covering only 10 acres shows the same volume of seed use by ducks as another plant species covering 100 acres, the two plants should not be considered of equal value as duck food sources; indications are that the plant species occupying 10 acres is potentially 10 times as valuable as the species occupying 100 acres.

The shortcoming in the method of determining the value of various plants as food for waterfowl has been evident to several investigators. For instance, Martin & Uhler (1939) in commenting on the percentage and ranking of duck food items in several tables state that "it will be desirable to have more extensive, careful field observations to supplement present conclusions, which are founded primarily on laboratory analyses." Concerning the heavy use made by ducks of pondweed and sedge seeds, Pirnie (1935) says that this may reflect abundance of the seeds rather than preference of ducks for these seeds. McAtee (1918) states that "superior availability after all is the guiding principle in the choice of food by birds."

The writers,* 1938-1940, had the opportunity to make an intensive study of the occurrence and use of duck food plants in the Illinois River valley. A preliminary report covering the results of the 1938 investigation has been issued (Bellrose & Anderson 1940). Because altered water levels in 1939 and 1940 greatly changed the food resources of many bottomland lakes through the development of extensive communities of moist-soil plants, it is thought desirable to summarize at this time the data for all 3 years.

Method of Rating Food Plants

In the present paper, the authors have attempted to obtain a numerical rating of the value of certain waterfowl plants by dividing the per cent of use made by ducks of the plant parts by the per cent of abundance of the plants. Per cent of use data are based on the volumetric

*Field work relating to plant species was done by Bellrose, then as now Assistant Game Technician of the Illinois Natural History Survey. Analyses of stomach contents was the work of Anderson, at the time employed by the Survey as Junior Biologist on Project 2-R of the Federal Aid in Wildlife Restoration Program, carried on in cooperation with the State Department of Conservation and the U. S. Fish and Wildlife Service.

measurement of the contents of 3,200 gizzards gathered at duck clubs during the 1938, 1939 and 1940 hunting seasons (Anderson ms.). Table 1 reveals the numbers of stomachs and the various species of ducks represented. The sample of dabbling duck gizzards is fairly proportionate to the occurrence of the different species of this type of duck in the Illinois River region. The sample of diving duck gizzards is not adequately representative of the occurrence of this waterfowl group in the region.

Table 1.—Duck stomachs examined in the present study.

Duck	1938	1939	1940	Total
Mallard	619	928	360	1,907
Pintail	222	408	39	669
Green-winged teal	98	127	—	225
Blue-winged teal	51	59	—	110
Baldpate	33	49	—	82
Gadwall	3	33	—	36
Shoveler	16	23	—	39
Canvasback	14	1	—	15
Ringneck	72	9	—	81
Lesser scaup	2	1	—	3
Other ducks	17	10	6	33
Total	1,147	1,648	405	3,200

Considered in this paper are only uncultivated aquatic and moist-soil plants. Corn, usually an important duck food plant in the Illinois River valley, is not included in the calculations.

Per cent of abundance data are based upon the surface area in acres of the aquatic and moist-soil beds at the various lakes studied; this area in each case was obtained by plotting the vegetation by aspection and rough triangulation on large scale base maps and using a planimeter to measure the area covered by each species (Bellrose 1941). Table 2 gives the total area of aquatic and moist-soil vegetation for the lakes considered in this paper, and the number of gizzards examined from each area.

An index rating of 1.0 for a food plant indicates that this plant was used approximately in proportion to its abundance. The larger the figure, the greater is the value of the plant species as a duck food. Conversely, the smaller the figure, the lower is the value of the species.

We do not wish to pretend that the index figures listed here are the final and absolute evaluation of the food plants enumerated. Habits of waterfowl, plant differences, plant habitat characteristics, and inaccuracies in determining abundance of vegetation are factors tending to prevent minutely exact rating figures. Ducks killed at any one lake may or may not have obtained their last meal there. Plant items in stomachs and banding data reveal that occasionally ducks have fed 10 or 100 or more miles from the place in which they are shot.

Food habits of various species of ducks differ widely, too, so that coontail may rank high at a certain place because of presence of many baldpates and gadwalls, or nutgrasses and pigweeds may rank high at another place because pintails and teals are abundant there.

In some instances changes in the ranking of a plant from year to year are due

Table 2.—Number of acres of duck food plants at various lakes in the Illinois River valley and the number of duck stomachs examined from each area.

Area	1938		1939		1940	
	Acres of Vegetation	Number of Stomachs	Acres of Vegetation	Number of Stomachs	Acres of Vegetation	Number of Stomachs
Duck Island	1,255	207	1,539	162	—	—
Clear and Chautauqua Lakes	1,441	358	2,022	531	2,389	134
Crane Lake	425	293	466	342	531	142
Cuba Island	329	289	441	355	—	—
Douglas Lake	—	—	1,686	98	—	—
Goose Pond	—	—	908	160	968	129
Total	3,450	1,147	7,062	1,648	3,888	405

to changes in seed production resulting from changes in environment. Such changes are well illustrated by water hemp at Clear Lake. In 1940, because of water level changes that reduced seed yield, water hemp had an index rating only half as great as in the previous year. Among aquatic plants, giant bur-reed, marsh smartweed and sago pondweed are notable as species that vary greatly in the yield of seed with variances in environmental conditions.

In some years, plant seeds present in abundance may be inaccessible to all or some ducks through the absence of water or through a depth of water too great for dabbling species. In other years, seeds of plants not present in those years may be available from previous years. For example, in 1938, be-

Fig. 1.—Rice cut-grass (*Leersia oryzoides*), or sawgrass, in most years and in most Illinois River valley habitats leads all other uncultivated plants in value as a source of food for ducks. Not only is this species valuable for its seed, which it produces in fair abundance, but its rootstocks and shoots also furnish food for waterfowl.

cause of high water, moist-soil plants—millets, smartweeds, nutgrasses and the like—were almost nonexistent in the Illinois River valley. Yet stomach analyses revealed that seed of these species formed almost one-fourth of the uncultivated foods taken. Noting that thousands of ducks were feeding on apparently barren mud flats and in shallow water, we conjectured that these waterfowl were consuming seeds deposited from plant beds occurring there in 1936 and 1937.

To ascertain the validity of this conjecture, in 1940 we collected from three places mud samples aggregating 18 square feet of surface. These samples yielded 2,500 seeds of *Cyperus erythrorhizos*, 2,000 seeds of *C. strigosus* and 550 seeds of water hemp, *Acnida tuberculata*. No plants had grown on these mud flats for 3 years. We believe that our findings substantiate the premise that large quantities of seeds deposited in one year may be available as food in succeeding years in which germination is precluded by unfavorable environmental conditions.

The areas of the various plant beds, as determined from the maps, are only approximate. In certain places there are seasonal changes in the plant communities, changes that result in error in calculating the abundance of the species

Table 3.—Per cent of use, per cent of abundance, and index value of aquatic and moist-soil plants at certain lakes in the Illinois River valley, 1938-40. Areas included are listed in table 2.

Plant	Per Cent of Use	Per Cent of Abundance	Index Value
Rice cut-grass	25.53	1.93	13.32
Walter's millet	6.19	0.58	10.67
Nutgrasses	10.85	1.53	7.12
Largeseed, nodding and other smartweeds*	4.44	1.09	4.07
Japanese and wild millets	11.76	3.45	3.41
Giant bur-reed	0.26	0.10	2.60
Coontail	15.09	7.91	1.91
Duck potato	2.73	2.79	0.98
Marsh smartweed	6.60	7.87	0.84
Buttonbush	2.62	1.13†	med.
Longleaf pondweed	3.19	5.88	0.54
Spike rushes	0.16	0.34	0.47
Teal grass	1.99	0.02†	?
Water hemp	3.02	8.80	0.34
Marsh cord grass	0.05	0.21	0.24
White waterlily	0.08	0.74	0.10
Sago pondweed	0.55	5.55	0.10
River bulrush	0.50	26.02	0.02
American lotus	0.35	23.26	0.02
Pickerelweed	tr.	0.01	low
Marsh mallow	tr.	0.01	low
Southern naiad	tr.	0.12	low
Wild rice	0.00	0.59	v. low
Small pondweed	0.00	0.05	v. low
Longleaf ammannia	0.00	0.02	v. low
Other plants	3.72	**	....

*Other than marsh smartweed. †Because of difficulty of measuring abundance of these plants, these figures are not accurate but represent minimum abundance. **No figure because of difficulty of measurement. tr.=trace. ab.=abundant. v. low=very low. med.=medium.

Table 4.—Per cent of use, per cent of abundance, and index value of aquatic and moist-soil plants at certain lakes in the Illinois River valley, 1938. Areas included are listed in table 2.

Plant	Per Cent of Use	Per Cent of Abundance	Index Value
Rice cut-grass	28.46	0.73	39.00
Coontail	22.72	14.20	1.68
Nutgrasses	11.73	tr.	high
Marsh smartweed	9.61	14.43	0.66
Longleaf pondweed	5.85	13.48	0.43
Buttonbush	3.49	ab.	low
Teal grass	3.16	tr.	med.
Water hemp	2.17	tr.	med.
Largeseed, nodding and other smartweeds*	1.63	tr.	med.
Duck potato	1.40	7.14	0.20
Sago pondweed	0.89	8.81	0.10
American lotus	0.38	28.30	0.01
Giant bur-reed	0.35	tr.	low
River bulrush	0.30	9.97	0.03
White waterlily	0.21	0.80	0.26
Marsh cord grass	0.15	0.70	0.21
Spike rushes	0.05	1.04	0.05
Pickerelweed	0.00	0.40	v. low
Southern naiad	0.00	tr.	v. low
Mud plantain	0.00	tr.	v. low
Other plants (total of 50)			

*Other than marsh smartweed. **No figure given because of difficulty of measurement. tr.=trace. ab.=abundant. med.=medium. v. low=very low.

involved. A noticeable error occurred in the case of teal grass, *Eragrostis hypnoides*, because millets, pigweed and other plants growing over this species when the areas were surveyed made it virtually impossible to plot.

It may seem that the discrepancies enumerated above outweigh the benefits derived from this method of evaluation. However, we believe that, despite its limitations, the use-abundance rating gives a far more nearly accurate picture of the food value of a plant than do percentages based solely upon the amount of food taken.

Because of the different factors that may affect the availability of seeds or other plant parts of a particular species in any one year, it seems advisable to include yearly tables as well as a general summary table. Comparisons between years will aid in determining the influences of altered habitat conditions on the food value of plant species.

Table 5.—Per cent of use, per cent of abundance, and index value of aquatic and moist-soil plants at certain lakes in the Illinois River valley, 1939. Areas included are listed in table 2.

Plant	Per Cent of Use	Per Cent of Abundance	Index Value
Walter's millet	9.37	0.26	36.04
Rice cut-grass	22.25	1.47	15.13
Nutgrasses	10.83	0.72	15.04
Japanese and wild millets	14.82	5.44	2.72
Duck potato	3.94	1.48	2.66
Largeseed, nodding and other smartweeds*	3.13	tr.	high
Spike rushes	0.25	0.10	2.50
Buttonbush	2.64	1.16†	med.
Giant bur-reed	0.44	0.20	2.20
Coontail	13.62	6.28	2.19
Marsh smartweed	7.75	6.73	1.15
Teal grass	1.54	tr.	med.
Longleaf pondweed	2.11	2.24	0.94
Water hemp	1.65	2.22	0.74
Sago pondweed	0.38	6.14	0.06
American lotus	0.43	25.29	0.02
River bulrush	0.65	37.47	0.02
Pickerelweed	tr.	0.03	low
Marsh mallow	tr.	0.02	low
White waterlily	tr.	1.15	low
Wild rice	0.00	1.22	low
Marsh cord grass	0.00	0.26	low
Southern naiad	0.00	0.12	low
Other plants	4.20	**	

*Other than marsh smartweed. **No figure given because of difficulty of measurement. tr.=trace. med.=medium. †Minimum figure.

Ratings of Food Plants Studied

The value, as food for ducks, of the moist-soil and aquatic plants commonly occurring in the Illinois River valley is based on data presented in tables 3–6.

Rice cut-grass, *Leersia oryzoides*, fig. 1, outranks all other species in food value for the 3-year period, table 3. In 1938 it ranked first by a wide margin, table 4. In 1939 it ranked second to Walter's millet, table 5; in 1940 it was slightly behind Japanese and wild millets combined, table 6. This variance in

Table 6.—Per cent of use, per cent of abundance, and index value of aquatic and moist-soil plants at certain lakes in the Illinois River valley, 1940. Areas included are listed in table 2.

Plant	Per Cent of Use	Per Cent of Abundance	Index Value
Japanese and wild millets	21.26	2.92	7.28
Rice cut-grass	28.72	4.15	6.92
Walter's millet	7.64	1.63	4.68
Largeseed, nodding and other smartweeds*	9.56	3.94	2.43
Nutgrasses	8.63	4.18	2.06
Duck potato	1.37	1.41	0.97
Coontail	3.60	5.16	0.70
Spike rushes	0.08	0.13	0.60
Buttonbush	0.71	2.05	0.35
Teal grass	0.97	0.08†	?
Water hemp	8.53	28.03	0.30
Longleaf pondweed	1.38	5.58	0.25
Sago pondweed	0.38	1.58	0.24
Marsh smartweed	0.73	4.06	0.18
River bulrush	0.39	20.34	0.02
American lotus	0.05	14.27	0.004
Southern naiad	0.00	0.22	low
Small pondweed	0.00	0.20	low
Longleaf ammannia	0.00	0.07	low
Others, many	6.00	**	

*Other than marsh smartweed. **No figure given because of difficulty of measurement. †Minimum figure.

value is brought about largely by local habitat changes. From studies made of seed production in 1941 by Low & Bellrose (ms.) it is apparent that dry soil greatly lowers the seed productivity of rice cut-grass; furthermore, unless there is an inch or two of water over the rootstocks during the fall, those items, which also are a waterfowl food, are not available to ducks. At several lakes where index values of rice cut-grass were obtained throughout the 3-year period, this plant ranked first at five and second at four areas. A check of the environmental conditions of these nine areas revealed that the first five were more favorable habitats for the plant than were the others.

Fig. 2.—Walter's millet (*Echinochloa Walteri*) outranks Japanese millet in certain habitats as a food for migratory waterfowl in the Illinois River region. While its favorable position may be due in most instances to greater seed production, it may be due at times to a diet preference on the part of pintails and teals.

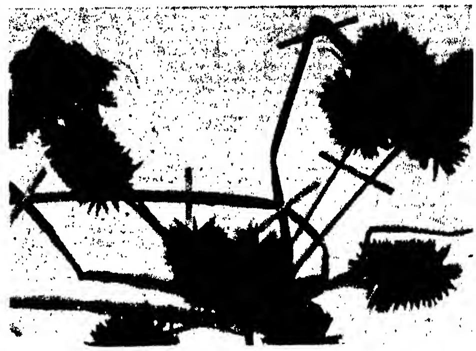

Fig. 3.—Nutgrasses (*Cyperus* spp.), as a group ranking fifth in value among Illinois River valley duck food plants, produce large quantities of minute seeds. Straw-colored cyperus (*C. strigosus*) is pictured here.

Walter's millet, *Echinochloa Walteri*, fig. 2, approaches rice cut-grass in value, according to the index figures in table 3. It is to be expected that, like many other plants, this species varies in value with the year and habitat, its value depending on its own seed production and the availability of other foods. Although Martin & Uhler (1939) regard the smaller seeds of this species less important as a duck food than those of wild millet, *E. crusgalli*, we believe that Walter's millet may locally, in certain years, be the more valuable species. For example, at Clear Lake in 1940, Walter's millet was slightly less abundant than wild and Japanese millets combined. However, Walter's millet amounted to 16.52 per cent of the native food plant items taken from the stomachs of ducks shot at this lake, while wild and Japanese millets totaled only 9.24 per cent.

We believe that the greater value of Walter's millet may lie in a generally heavier seed yield of this plant or in the fact that pintails and teals prefer the small seeds of this species to the larger ones of the other millets. We know that pintail and teal diets are made up of smaller seeds than are those of mallards, baldpates, gadwalls and the like, and that the number of pintail and teal

stomachs analyzed from Clear Lake was proportionally larger than at lakes at which Walter's millet did not rank so high. Low & Bellrose (ms.) found that, in 1941, wild and Japanese millets produced considerably greater quantities of seed per unit of area than did Walter's

Fig. 4.—Largeseed smartweed (*Polygonum pennsylvanicum*), in contrast to nodding smartweed, has thick, erect spikes. This and other moist-soil smartweeds constitute a group that appears to be slightly more valuable than the nutgrasses, but less valuable than the millets, as a source of food for migratory waterfowl.

millet. However, in that year, high water so retarded growth of Walter's millet that plants were only 2 to 5 feet high, whereas in 1939 and 1940 they were 7 to 9 feet high. The taller plants had considerably larger inflorescences and therefore produced much more seed.

Nutgrasses, fig. 3, are in third position in table 3. Although the index rating derived from data obtained in all 3 years places this group, *Cyperus erythrorhizos*, *C. strigosus* and *C. esculentus*, third in value, we believe that an inaccuracy in figures resulted from the fact that waterfowl fed on seeds deposited prior to 1938 on mud flats that were bare in that year and that were therefore recorded as supporting no nutgrass plants. All evidence points to the fact that a somewhat similar situation occured in 1939, when water prevented plants from appearing on many areas. In 1940, water levels were low earlier than in the 2 preceding years, so that by fall all mud flats were covered by a rank growth of vegetation. We believe that

Fig. 5.—Nodding smartweed (*Polygonum lapathifolium*) grows on mud flats and other moist places. Its long, drooping, densely flowered spikes distinguish it from other smartweeds.

the index value as given in 1940 for this species is the most nearly accurate, table 6. This rating placed the nutgrasses above duck potato in value— the numerical value was over twice as great,

in fact—but below the group consisting principally of nodding, large-seed and swamp smartweed.

The relative value of the three species of nutgrasses may be judged by the following facts: *Cyperus erythrorhizos*, represented by 56.5 per cent of the total nutgrass seed found in duck gizzards, was much more abundant than *C. strigosus*, represented by 19.0 per cent of the nutgrass seed; *C. esculentus*, however, made up 24.5 per cent of the total nutgrass seed, even though less abundant than *C. strigosus*. This would indicate that *C. esculentus* was slightly better than *C. erythrorhizos*, which, in turn, was better than *C. strigosus*.

Moist-soil smartweeds, consisting of largeseed smartweed, *Polygonum pennsylvanicum*, fig. 4, nodding smartweed, *P. lapathifolium*, fig. 5, swamp smartweed, *P. hydropiperoides*, and minor quantities of other species, rank fourth for the 3-year period, table 3. However, here also the same factors prevail that were responsible for an error in the index value of the nutgrasses: in many places seeds deposited in one year were consumed the next, when germination did not occur and plants were not recorded. The 1940 index rating of 2.43 in table 6 is probably the most nearly accurate. It places these species slightly above the nutgrasses in value.

Fig. 6.—Japanese millet (*Echinochloa frumentacea*) under favorable growing conditions is one of the greatest seed producers among the duck food plants of the Illinois River valley. Because its seed production is greatly dependent on growing conditions, its comparative value ranges from excellent to fair in the course of several years.

Wild and Japanese millets, *Echinochloa crusgalli* and *E. frumentacea*, fig. 6, appear fifth in order of preference in table 3, covering 1938, 1939 and 1940. For some reason, waterfowl did not obtain appreciable amounts of seed of these species from mud flats in 1938. Had they done so, the status of these millets would undoubtedly have been raised above that of the smartweeds. Table 6 shows that Japanese and wild millets headed the list in 1940, when they were slightly better than rice cutgrass.

Fig. 7.—Giant bur-reed (*Sparganium eurycarpum*) ranks sixth as a duck food plant in the Illinois River region. Its value here is considerably higher than it is generally accorded elsewhere. The globose heads are composed of nutlike, beaked seeds that are eaten by ducks.

As in other species, millets vary in seed yield with habitat conditions. Furthermore, time of planting greatly affects seed production. Japanese millet sown in the Illinois River valley after

Fig. 8.—Coontail (*Ceratophyllum demersum*) ranks below the moist-soil plants in value as a source of food for waterfowl, but leads the truly aquatic species. Ducks feed mainly on its leaves and stems.

Aug. 1 often fails to ripen before frost. On the other hand, this millet sown in June may mature, the seed shatter and germinate the same summer. In the Illinois River valley this second growth of millet has never matured before frost. We do not know just how operative the above conditions were in lowering the value of this species in 1939, but we know that the water receded in many lake basins 2 weeks earlier in 1940 than in 1939 to give the millet a longer growing season.

Giant bur-reed, *Sparganium eurycarpum*, fig. 7, with an index value in table 3 of 2.60, ranks as a much better duck food plant in the Illinois River valley than it is generally believed to be. Studies by Low & Bellrose (ms.) in 1941 on the seed yield of this species reveal that it produced about three times as much seed in areas with stable water levels as in areas with semistable water levels. In the various types of areas combined, giant bur-reed in 1941 produced more seed per unit of area than either largeseed or nodding smartweed.

Coontail, *Ceratophyllum demersum*, fig. 8, ranking slightly below giant bur-reed in value, table 3, is an excellent

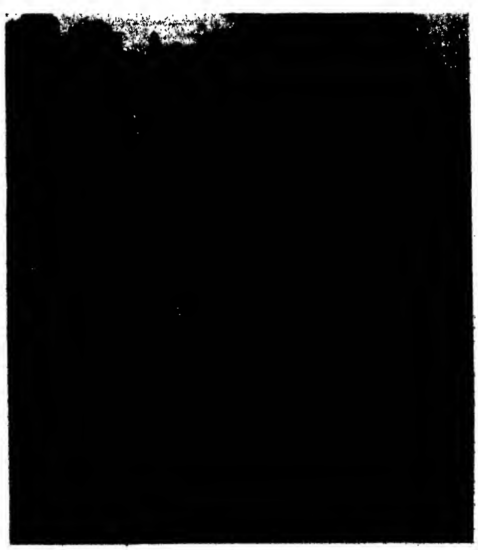

Fig. 9.—Duck potato (*Sagittaria latifolia*) is valued by ducks more for its seed than for its large, deeply buried tubers.

food for baldpates and gadwalls. It furnishes little seed, but ducks make extensive use of the leaves and stems.

Teal grass, *Eragrostis hypnoides*, has a status that cannot be judged by any index figures derived from use and abundance data recorded for this species, tables 3, 4, 5 and 6. This is evident from the fact that in 1938 and 1939 it formed respectively 3.16 and 1.54 per cent of the food taken, while only a few small patches of plants were seen on extensive mud flats around several lakes. In all probability, ducks in those years obtained seeds deposited by growths of previous seasons. This small, procumbent plant in 1940 was overgrown by pigweeds, millets and smartweeds to such an extent that accurate mapping of the areas covered by the numerous scattered patches was impossible.

From its relatively high use and apparently low occurrence, we believe that teal grass ranks above duck potato in

Fig. 10.—Marsh smartweed (*Polygonum Muhlenbergii*), one of the few smartweeds that grows in water, can readily be identified by its bright pink blossoms. It is not so valuable a duck food plant as largeseed or nodding smartweeds because it does not produce so much seed.

Fig. 11.—Longleaf pondweed (*Potamogeton americanus*) ranks eleventh among Illinois River valley plants as a source of duck food. It ranks above sago pondweed apparently because it produces more seed.

value, but below the nutgrass group. Seed production studies (Low & Bellrose ms.) revealed that in 1941 teal grass produced about half as much seed as *Cyperus erythrorhizos* and almost as much as did duck potato per area unit.

Duck potato, *Sagittaria latifolia*, fig. 9, has an index value, table 3, about two-fifths as great as that of giant bur-reed. Incidentally, in 1941, bur-reed produced about two-fifths more seed per unit of area than did duck potato. For the most part, the large tubers of duck potato, often a foot or more underground, are not available as duck food. However, at times canvasbacks and ringnecks have succeeded in obtaining numerous tubers, which considerably raised the value of duck potato for certain areas.

Marsh smartweed, *Polygonum Muhlenbergii*, fig. 10, has in table 3 an index value of 0.84, which places it slightly below duck potato. Beds of this species will not produce seed when growing out of water; optimum production occurs in water 12 to 18 inches deep. In several areas, beds produced no seed because of a lack of water. This species would rank somewhat higher if all the beds that failed to produce seed were excluded from the calculations.

Longleaf pondweed, *Potamogeton americanus*, fig. 11, ranks below marsh smartweed in index value, table 3, despite the fact it outproduces the latter in seed yield by a wide margin. This may indicate that, because of the greater depth of water at which the plants grow, seeds of aquatic plants are less accessible to dabbling ducks than are those of marsh plants.

Buttonbush, *Cephalanthus occidentalis*, seldom grows in the areas that were mapped, occurring usually as a part of, or within, the shoreline. Since it is also a woody species, its abundance was not determined for most areas. However, in the Crane Lake region, its abundance was determined in 1939 and 1940. When there was a dearth of other duck foods in this area, 1939, the index rating was 0.94; when there was an abundance of other foods, 1940, the index rating dropped to 0.12. A study of the food consumption on

other areas substantiates the Crane Lake observations. Seed production of buttonbush is not known to vary greatly from year to year; therefore, we must conclude that ducks do not relish the seeds and that these seeds are sufficiently palatable to be taken extensively only when other foods are lacking.

Spike rushes, *Eleocharis* spp., include mainly the *Eleocharis palustris* group. These short, round-stemmed species, growing on moist soil or in shallow water may be excellent duck foods in some years and poor foods in others, as illustrated by the index values in tables 4, 5 and 6. Tables 5 and 6 show that, in 1939 and 1940, spike rushes formed about the same per cent of vegetation at the lakes studied. Yet in the first year the seed of these species consumed by ducks was three times as great as in the second year. We are at a loss to account for this variance. The 3-year index rating for these species places their duck food value slightly below that of the longleaf pondweed, table 3.

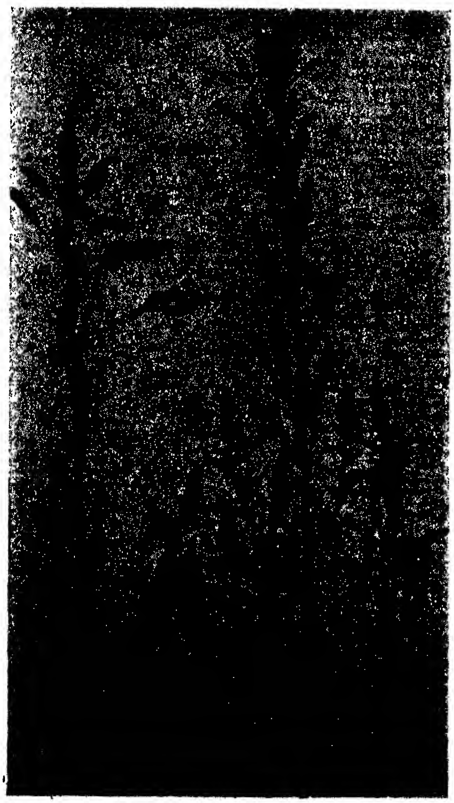

Fig. 12.—Water hemp (*Acnida tuberculata*) better known as pigweed, is generally a large, coarse moist-soil plant. It is of lower value as a source of duck food than are most other species growing on the Illinois River mud flats.

Water hemp, *Acnida tuberculata*, fig. 12, a large, coarse herb growing on drier soil sites than other moist-soil plants, has small seeds, pin-headed in shape, that may not always be as available as seeds of the other species of this group. Its index value for 1938–40 is 0.34, table 3. The data include seeds produced prior to 1938, a year in which only a very few plants of this species grew in the areas studied. The 1940 rating of 0.30 is probably the best indicator of its true value, table 6. Such moist-soil plants as smartweeds, millets and rice cut-grass are apparently about 10 to 40 times as good sources of duck food as is water hemp.

Marsh cord grass, *Spartina Michauxiana*, may be a fair duck food, as shown in table 3, with an index value of 0.24. This figure places it in a better position as a duck food in the Illinois River valley than it is customarily accorded elsewhere.

Sago pondweed, *Potamogeton pectinatus*, fig. 13, is generally regarded as one of the most excellent duck foods on the North American continent. However, it falls far short of this ideal in the Illinois River valley. Tables 4, 5 and 6 show that its 1938 index rating was 0.10, its 1939 rating was 0.06 and its 1940 rating was 0.24. Table 3 shows a 3-year index value of 0.10. The low status of this highly rated species in the Illinois River region is due to its low seed yield here. Very little foliage and few tubers of this species were found in the 3,200 gizzards analyzed.

The apparently low seed yield of sago pondweed was substantiated by studies made in 1941 by Low & Bellrose (ms.), which revealed that this plant produced less seed per area unit than 23 other aquatic and moist-soil plants in the Illinois River valley.

White waterlily, *Castalia tuberosa*, has an index figure of 0.10 for the 3-year period, table 3. However, its value may vary from year to year and place to place, depending on its own seed yield and on the presence or absence of other

Fig. 13.—Sago pondweed (*Potamogeton pectinatus*) has the reputation of being one of the best waterfowl food plants in North America. However, in the Illinois River valley it ranks sixteenth among 25 species or groups. Its low rating in Illinois appears attributable to its low seed yield in this area and to the fact that its foliage is seldom found in duck gizzards here.

food resources. A serious paucity of other duck food plants in 1938 may have accounted for its unusually high rating of 0.26 in that year, table 4; when other food resources were greater, 1939, its index rating was less than 0.02, table 5. At Crane Lake in 1938, white waterlily rated 0.19, but it dropped to 0.01 in value the following year. This was doubtlessly due to the inhibition of fruiting caused by low water. The above data rank this species as poor to fair in food value, somewhat higher than the American lotus.

Pickerelweed, *Pontederia cordata*, fig. 14, is not given a numerical value in table 3. It was impossible to secure an index figure for this plant covering the 3-year study period because of the infinitesimal amounts of seed consumed by ducks. An index value of 0.03, derived from data obtained in 1939 at Crane Lake, places pickerelweed for that year and area above river bulrush and American lotus. If its low value is adequately portrayed by this small

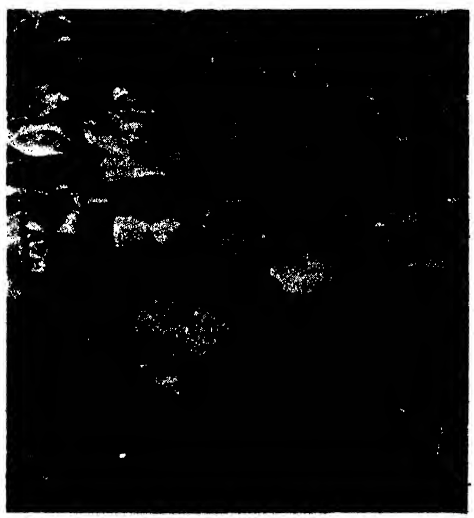

Fig. 14.—Pickerelweed (*Pontederia cordata*) is of doubtful value as a duck food plant in spite of the fact that it is one of the top-ranking seed producers in the Illinois River region. Its blue flowers and heart-shaped leaves distinguish it from duck potato, which has white blossoms and arrowhead-shaped leaves.

sample, then the low use must be due to low palatability rather than lack of availability, for this species is one of the top-ranking seed producers, as shown by a 1941 study (Low & Bellrose ms.).

River bulrush, *Scirpus fluviatilis*, a coarse, dominant marsh plant, frequently forms dense beds of 50 to 700 acres in the Illinois River valley. Only rarely in this area does it fruit, and then only in small patches; seeds are seldom available for food. This circumstance accounts for the fact that although river bulrush formed over 26 per cent of the vegetation for the 3-year study period, its seed accounted for only 0.50 per cent of the uncultivated plant parts consumed by waterfowl; its index value for the 3-year period is 0.02, table 3. At Lake Chautauqua, in 1938, when river bulrush beds produced more than the usual amount of seed, the index value of this plant for the area was 0.23.

Since river bulrush covers extensive areas that might well be occupied by more valuable food producers, it must be regarded as one of the most pernicious weeds in many waterfowl habitats of the Illinois River valley.

American lotus, *Nelumbo lutea*, fig. 15, is next to river bulrush in abundance in lakes adjacent to the Illinois River. Unlike this bulrush, however, lotus produces a fair amount of seed. Yet its index rating is 0.02, table 3, the same as river bulrush. Its slight value as a duck food and its dominance over many other aquatic plants of greater value make this species a weed in the migratory waterfowl habitats of the Illinois River valley.

Its low value as a duck food plant during October and November must be attributed to the unpalatability of the hard, nutlike seeds. Field observations indicate that before the seeds fully ripen, in late August and early September, wood ducks feed extensively on them. At that time the pericarp and cotyledons of the seed are soft.

Marsh mallow, *Hibiscus militaris*, is not generally regarded as a waterfowl food plant. However, in the 3-year investigation period it averaged 0.01 per cent of the vegetation of the marshes studied, table 3, and a few seeds were consumed by ducks.

Southern naiad, *Najas guadalupensis*, is apparently a poor duck food in the Illinois River valley. While it formed 0.12 per cent of the vegetation on the areas studied, table 3, only a smattering of seeds was found in the gizzards analyzed. Martin & Uhler (1939), in commenting on the value of the northern and southern naiads in the country as a whole, term them excellent duck foods.

Wild rice, *Zizania aquatica*, fig. 16, is often regarded as the food supreme for waterfowl. This may well be the case in regions where its abundance is measured in thousands of acres. However, despite the fact that it formed beds of 3 to 81 acres in several Illinois River valley lakes, none of its seeds were found in any of the duck stomachs analyzed, table 3. A possible explanation for the absence of seeds may be that few were available, for in August and September thousands of red-winged blackbirds were observed feeding on the ripening seed. Seeds that escape the blackbirds may be inaccessible among the vegetation debris and muck of the lake bot-

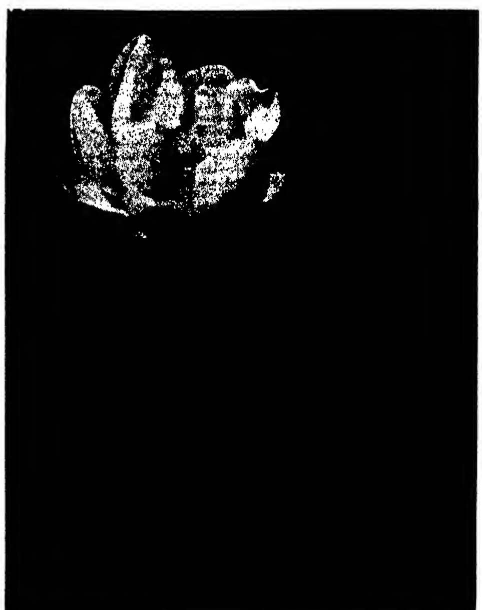

Fig. 15.—American lotus (*Nelumbo lutea*), or yorkey nut as it is often called locally, is seldom utilized by ducks despite its abundance. Its low value as a food plant is due probably to the unpalatability of its hard, nutlike seeds.

toms; most of the seeds fall a month before the greatest numbers of ducks arrive. McAtee (1939, p. 33) in commenting on the value of wild rice states: "This plant has a great reputation as a producer of food for wildfowl—too high a rating, perhaps, considering its local and seasonal availability."

Small pondweed, *Potamogeton pusillus,* is another species that is generally

Fig. 16.—Wild rice (*Zizania aquatica*) is not a valuable duck food plant in the Illinois River valley; few of the seeds are available during the season of the principal waterfowl flight in the fall months.

considered a good waterfowl food plant. Although it amounted to 0.05 per cent of the vegetation, table 3, no foliage or seeds were found in any of the stomachs analyzed. Studies of seed yield in 1941 (Low & Bellrose ms.) revealed that it was one of the lowest producers. We have noted that the vegetative parts, after fruiting time in late July and early August, generally disintegrate. Whether disintegration is caused by green algae, by the competition of coontail and southern naiad, or by some unknown factor, we do not know.

Longleaf ammannia, *Ammannia coccinea,* is a moist-soil plant that has occurred fairly abundantly at Clear Lake. No evidence was obtained that this species was ever used as food by ducks, table 3.

Plant parts of a large number of other species were consumed in infinitesimal amounts; likewise some other species were found in the field in amounts too small to tabulate, table 3.

Discussion

That the true value to waterfowl of the various aquatic and moist-soil plants cannot be determined solely from the use made of them by the birds is evident after consideration of a few outstanding instances. Based solely on use, Walter's millet ranks sixth in value among duck food plants of the Illinois River valley, slightly below marsh smartweed, table 3. When abundance as well as use is considered, Walter's millet is second in rank, nearly 13 times as great in value as marsh smartweed, which places ninth in value, table 3. In another instance, based on use only, coontail ranks second, three-fifths as valuable as the leading rice cut-grass; however, after the abundance figure is considered, coontail drops to seventh place, with about one-seventh the value of rice cut-grass. Giant bur-reed, according to use made by ducks, ranks sixteenth in value. When the meager occurrence of the bur-reed is taken into consideration, it jumps to sixth in value.

Although many extraneous and diverse factors have prevented us from obtaining exact values for duck food plants, we believe that, by considering both the abundance and use of such plants, it is possible to ascertain more nearly the true value of plant species, as food for waterfowl, than by using data based solely on the quantity of the items taken.

What determines the duck food value of various aquatic plants? Logically, availability and palatability are two most important factors. We believe evidence discussed in this paper shows that availability, as measured by food yield and accessibility, determines the value of most plants generally considered as sources of duck food. It should be noted that, in many species, seed yield and value go hand in hand. In other species, depth of water evidently affects availability, through making the food source less, or more, easily accessible to ducks, especially dabbling ducks. We may tentatively assume that seeds of moist-soil plants are more

easily accessible than those of emergent aquatic species, which, in turn, are more easily accessible than floating or submerged aquatic plants.

That palatability plays an important role in determining the food value of several species is also quite evident. Both the pickerelweed and buttonbush are heavy seed producers, the food is fairly accessible, and yet the index value is low. American lotus is a medium food producer, the seeds are fairly accessible, and yet the index value is very low. Palatability in these species must be the operative factor in determining their meager use by ducks.

Summary

Employing data based upon the occurrence of the plants, as well as upon consumption by ducks of the plant parts, the writers have attempted to present an accurate appraisal of the value of certain plants of the Illinois River valley as waterfowl food sources.

By dividing the per cent of use made by ducks by the per cent of abundance of the important aquatic and moist-soil plants occurring in the valley, it was possible to secure an index figure of value for each of these species. We believe the figures obtained to be far more reliable indicators of value as waterfowl food sources than are data derived only from plant parts taken by the birds.

Numerous factors, such as seed production and accessibility, influence sources of supply that vary with the habitat and year. Taking cognizance of these variables (as discussed under each species) makes it seem advisable to judge the value of each species on the figures for no one year, but to use the index value for the year or years that seem most typical. This procedure places 25 plants or groups in the following descending order of value as food for ducks in the Illinois River valley, 1938, 1939 and 1940. Tables 3, 4, 5 and 6 give comparative values for species and years.

Excellent Duck Food Sources

1. Rice cut-grass, *Leersia oryzoides* (Linnaeus) Swartz
2. Walter's millet, *Echinochloa Walteri* (Pursh) Nash
3. Wild and Japanese millets, *Echinochloa crusgalli* (Linnaeus) Beauvois and *E. frumentacea* (Roxburgh) Link, respectively
4. Moist-soil smartweeds
   a. Largeseed smartweed, *Polygonum pennsylvanicum* Linnaeus
   b. Nodding smartweed, *Polygonum lapathifolium* Linnaeus
   c. Swamp smartweed, *Polygonum hydropiperoides* Michaux
   d. Miscellaneous, *Polygonum* spp.
5. Nutgrasses
   a. Chufa, *Cyperus esculentus* Linnaeus
   b. Red-rooted cyperus, *Cyperus erythrorhizos* Muhlenberg
   c. Straw-colored cyperus, *Cyperus strigosus* Linnaeus

Good Duck Food Sources

6. Giant bur-reed, *Sparganium eurycarpum* Engelmann
7. Coontail, *Ceratophyllum demersum* Linnaeus
8. Teal grass, *Eragrostis hypnoides* (Lamarck) Britton, Sterns & Poggenberg
9. Duck potato, *Sagittaria latifolia* Willdenow
10. Marsh smartweed, *Polygonum Muhlenbergii* (Meisner) Watson
11. Longleaf pondweed, *Potamogeton americanus* Chamisso & Schlechtendal

Fair Duck Food Sources

12. Buttonbush, *Cephalanthus occidentalis* Linnaeus
13. Spike rushes, principally *Eleocharis palustris* (Linnaeus) Roemer & Schultes
14. Water hemp, *Acnida tuberculata* Moquin-Tandon
15. Marsh cord grass, *Spartina Michauxiana* Hitchcock
16. Sago pondweed, *Potamogeton pectinatus* Linnaeus
17. White waterlily, *Castalia tuberosa* (Paine) Greene

POOR DUCK FOOD SOURCES

18. River bulrush, *Scirpus fluviatilis* (Torrey) Gray
19. American lotus, *Nelumbo lutea* (Willdenow) Persoon
20. Pickerelweed, *Pontederia cordata* Linnaeus
21. Marsh mallow, *Hibiscus militaris* Cavanilles
22. Southern naiad, *Najas guadalupensis* (Sprengel) Morong
23. Wild rice, *Zizania aquatica* Linnaeus
24. Small pondweed, *Potamogeton pusillus* Linnaeus
25. Long-leaved ammannia, *Ammannia coccinea* Rottboell

It should be noted that the five leading plants, or groups, are moist-soil species. The moist-soil plants as a group are better seed-yielders than the truly aquatic plants and their seeds are more readily available to most ducks.

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Volume 22 BULLETIN Article 6

Survey of the Illinois Fur Resource

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PREFACE

THE two studies presented here, *Survey of the Illinois Fur Resource* and *Illinois Furbearer Distribution and Income*, represent sincere attempts to obtain by different methods a reasonably reliable measure of the valuable fur resource of Illinois. Each study has certain inherent strengths and weaknesses. The oral survey, basis for the Brown & Yeager report, was intensive in its technique. The analysis of fur-takers' reports, basis for the Mohr report, was extensive. The Brown & Yeager data represent but 1.7 per cent of the area of the state, but within the strips actually surveyed were included all trappers, licensed and unlicensed, those who reported catches and those who did not. The Mohr figures represent every county in the state but they are selective in that, of necessity, they take into account only those trappers who reported their catches; that is, 10 to 23 per cent of the total number of licensed trappers. The Brown & Yeager data are based on oral answers given 15 days to over 14 months after the end of the trapping season covered by the questionnaire; no penalty for false answers was provided. The Mohr data are based on written answers given not later than the fifth day of the month next succeeding the month for which each report was made; persons making false answers could be prosecuted under the law. The Brown & Yeager report covers two trapping seasons; the Mohr report covers eight.

As must be expected in reports based on sampling, particularly sampling in which the human element plays an important part, calculated figures in these two reports do not coincide. However, the figures do not vary abnormally and, in nearly every instance of identical subject matter, a close correlation or parallel relationship exists between the two sets of figures.

The closeness of the corresponding figures and the degree of correlation between the two sets of figures indicate that, despite the errors that may have resulted from small or faulty sampling and despite possible errors resulting from inexact memory of persons questioned, the two reports give for the Illinois fur resource a picture so nearly accurate that it can serve as a useful guide in many matters pertaining to the fur-bearing animals of the state.

The two reports agree in placing the value of the annual fur take of Illinois at over $1,000,000, and they agree on the relative values of the various fur-bearing animals. The species that can profitably be fostered and those that cannot is clearly indicated by a study of the two reports.

The fur income of the state is still derived, as in pioneer years, from cropping a natural resource as it occurs in the wild, with very little conscious management by man. Much of the fur harvest is carried on by low income groups at a time of year in which other sources of income are scarce. Both of these facts should be considered in relation to the conservation or expansion of the Illinois fur industry and to the framing of laws regulating it.

The present reports are an outgrowth of earlier and less comprehensive studies by the Natural History Survey and its predecessors, some published (Wood 1910, Forbes 1912) and some not (Driver 1930, Rasmussen 1931). The fine cooperation of the State Department of Conservation, Springfield, Ill., has made possible the present more conclusive reports; for the Brown & Yeager study, this department made available special research investigation funds administered in cooperation with the U. S. Fish and Wildlife Service under terms of the Federal Aid in Wildlife Restoration Act, commonly known as the Pittman-Robertson Act, and for the Mohr report it provided essential records and information. The Natural History Survey is most appreciative of this assistance.

Mr. James S. Ayars, Technical Editor of the Survey, has contributed much to the accurate presentation and unification of the data of the two separate manuscripts involved and their adaptation to the general Survey format. His services in this connection are appreciated by all concerned.

T. H. FRISON, *Chief*
Illinois Natural History Survey

List of Illinois Mammals Discussed in Articles 6 and 7

Common Name	Scientific Name
Badger	*Taxidea taxus* (Schreber)
Beaver	*Castor canadensis* Kuhl
*Black bear	*Euarctos americanus* (Pallas)
Bobcat, wildcat, bay lynx	*Lynx rufus* (Schreber)
Coyote, brush wolf, prairie wolf	*Canis latrans* Say
Dog, wild dog	*Canis familiaris* Linnaeus
Domestic cat	*Felis domesticus* Linnaeus
*Fisher	*Martes pennanti* (Erxleben)
Gray fox	*Urocyon cinereoargenteus* (Schreber)
Least weasel	*Mustela rixosa* (Bangs)
Long-tailed weasel	*Mustela frenata* (Lichtenstein)
*Lynx, Canada lynx	*Lynx canadensis* Kerr
*Marten	*Martes americana* (Turton)
Mink	*Mustela vison* Schreber
Muskrat	*Ondatra zibethica* (Linnaeus)
Norway rat, house rat	*Rattus norvegicus* (Erxleben)
Opossum, possum	*Didelphis virginiana* Kerr
Otter	*Lutra canadensis* (Schreber)
*Puma, panther, mountain lion	*Felis concolor* True
Raccoon, coon	*Procyon lotor* (Linnaeus)
Red fox	*Vulpes fulva* (Desmarest)
Skunk	*Mephitis mephitis* (Schreber)
*†Spotted skunk, civet	*Spilogale putorius* (Linnaeus)

*Not now present in Illinois.
†Past occurrence in Illinois doubtful.

CONTENTS

Muskrat houses in three Illinois habitats: Turner Lake, Chain-o'-Lakes State Park, Lake County, Glacial Lakes Region (top); Lake Chautauqua, Chautauqua National Wildlife Refuge, Mason County, Central Sand Prairie Region (middle); Waltersburg, Pope County, Shawnee National Forest, River Bluffs and Bottoms Region (bottom). Used principally for construction were hardstem bulrush in the Lake County lodge, marsh smartweed in the Mason County lodge and cattail in the Pope County lodge. In all three cases, building material was taken from the immediately surrounding area. The muskrat, most important Illinois fur animal, shows considerable adaptability to environment.

Survey of the Illinois

Fur Resource*

LOUIS G. BROWN
LEE E. YEAGER

THE fur trade played an important part during the era of exploration and settlement in Illinois. Kaskaskia, the site of which is near Chester, Ill., and Cahokia, now a part of the St. Louis, Mo., metropolitan area, were important posts during the Revolutionary War period, when considerable quantities of Illinois fur were transported down the Mississippi River to New Orleans. Because of its strategic central location and proximity to the more important water routes, Fort Dearborn, located where part of Chicago now stands, early in the nineteenth century became a leading fur center of the vast Great Lakes–Mississippi valley region. The Illinois River became and long remained the principal avenue of the fur trade in the state, and most of the traffic was consigned to Chicago, Detroit and other Great Lakes centers. By the close of the Civil War, St. Louis dominated the fur trade in the Central States, and from that time until the present this city has received a large portion of Illinois furs. Many Illinois cities, including Peoria, La Salle, Kankakee, Danville and Cairo, had their beginnings as local posts in the fur trade.

The state's remarkably fertile soil and diversity in its prairie and forest types made for quality and variety in Illinois furs. Although the pelts of only a few fur species were important in the early trade, the Illinois fur animal fauna ranged from the lowly southern opossum to the valuable wilderness-inhabiting marten and fisher. The beaver, so important as to serve as a basis of exchange during the era of exploration in North America, did not occur in the same great abundance in the prairie state of Illinois as in the heavily forested regions farther north.

*Illinois Federal Aid Publication No. 3.

As settlement progressed in Illinois, most of the species intolerant of the changes effected by increasing human activities either retreated northward into the forests or were otherwise extirpated from the state; a few persisted in such small numbers that they are now of no commercial consideration. The long list of intolerant species includes the marten, fisher, timber wolf, panther, black bear, lynx, otter, beaver and bobcat. Of these, the marten and fisher were the first to go; the beaver has been reintroduced; and the otter and the bobcat may still occur in extremely limited numbers.

Common or farmland furbearers, such as muskrat, mink, raccoon, skunk, foxes, weasel and opossum, still persist throughout all or most of the state, though some in greatly reduced populations. The badger now has a very restricted range in Illinois, and the coyote, said to have been common during the buffalo or bison era, was later nearly exterminated, but is now reappearing in greater numbers. It is from the farmland species that the annual fur harvest has continued without interruption through the full duration of Illinois history. Despite all decimating factors, necessary and otherwise, affecting fur animals and their habitats, and despite the almost total lack of management, the Illinois fur resource returns an annual income of over $1,000,000 to the people of the state.

Officials charged with the administration of Illinois wildlife have come to appreciate the actual and potential values of the state's wild fur animals. Through this interest, they proposed the project on which this report is based. Formally designated as Project 1-R, "Illinois Fur Animal Resources Survey," this project was the first Illinois unit of the Federal

Aid in Wildlife Restoration Act program, and was approved by the Bureau of Biological Survey of the U. S. Department of Agriculture in May, 1939. The investigation was initiated on June 1, 1939, and completed on June 30, 1940.

PROJECT ADMINISTRATION

Supervision of Project 1-R, which was of the survey type of research, was assigned to the Illinois Natural History Survey by the Illinois State Department of Conservation. Dr. T. H. Frison, Chief, representing the Natural History Survey, and Mr. Anton J. Tomasek, representing the Department of Conservation, directed the project from the fiscal and administrative standpoints. Dr. Carl O. Mohr and the junior author, both of the Natural History Survey, jointly supervised the field work; and all project papers, reports and technical details were handled directly or under the immediate supervison of the latter.

The senior author was selected as leader of the project and served in this capacity until its termination. He was responsible for the field survey, a summarization of data and a preliminary draft of the main body of the paper.

ACKNOWLEDGMENTS

The writers make grateful acknowledgment to the following for assistance.

The Fish and Wildlife Service of the U. S. Department of the Interior (during the first part of this study the Bureau of Biological Survey of the U. S. Department of Agriculture) gave many helpful suggestions and much encouragement, officially extended through Mr. Albert M. Day and Mr. M. O. Steen.

Several members of the Illinois Natural History Survey staff aided materially. Dr. David H. Thompson gave much assistance with sampling and statistical problems after having directed two previous studies, some data from which are included in the Mohr* report. Dr. Ralph E. Yeatter, Mr. Arthur S. Hawkins and Mr. Frank C. Bellrose, Jr., aided in various ways.

Illinois State Department of Conservation game inspectors gave the project leader assistance which unquestionably increased the reliability of field data taken. The following were especially helpful: Sam Parr, Willis Spencer, Fred Ireland, William Pippin, Charles Dewis, Gene Fullenwider and Robert Graham.

Dr. R. S. Smith of the University of Illinois College of Agriculture and Agricultural Experiment Station was of great assistance in making the division of the state into fur survey regions. Mr. Douglas E. Wade, now of Dartmouth College, offered suggestions on field technique.

Dr. Herbert H. Ross, Dr. George W. Bennett, Dr. Carl O. Mohr, Mr. Robert E. Hesselschwerdt and Mr. James S. Ayars, members of the Illinois Natural History Survey Staff, took most of the habitat photographs. Dr. Charles F. Hottes, Professor of Plant Physiology, *Emeritus*, University of Illinois, kindly permitted use of the photograph represented by fig. 22.

Several leading fur companies and many Illinois fur buyers supplied valuable information. The writers wish particularly to thank the F. C. Taylor Fur Company, Hill Bros. Fur Company and the Abraham Fur Company of St. Louis, Mo., and Sears, Roebuck and Company of Chicago, all of which receive a considerable volume of Illinois raw furs. Mr. V. E. Hazel of Sears, Roebuck and Company was especially cooperative.

Finally, the writers' thanks are due to a great many individual hunters, trappers and others whose interest and cooperation have contributed to the completeness of this report.

REVIEW OF LITERATURE

There is relatively little published information on Illinois fur species. Kennicott (1857, 1858, 1859), in accounts of most fur animals of the state, including fisher and marten, gave early reports on the economics of these animals. He recognized the fur value and the rodent-destroying proclivities of fur animals, but for the most part his discussion is concerned with habits and predatory relationships. Cory (1912) supplied detailed accounts of the habits and known occurrence of Illinois mammals, but only a most general account of their economic importance. Forbes (1912) recognized that the fur resource

*Throughout this paper, the term *Mohr report* refers to "Illinois Furbearer Distribution and Income," by Carl O. Mohr, published with this paper as Article 7.

was significant and cited for 1910 valuations of $6,000 and $14,000 for minks and muskrats, respectively. The writers believe these figures are too low, even for the year involved.

In addition to the list by Cory, several other state and local lists of Illinois mammals have appeared. The best known are by Kennicott (1855), Thomas (1861), Hahn (1907), Wood (1910), Sanborn (1925), Gregory (1936), Necker & Hatfield (1941) and Mohr (1941). All except Hahn, Necker & Hatfield and Mohr describe the habits of Illinois fur animals in more or less detail. Kennicott, Sanborn and Gregory deal only with the Chicago area. Wood's studies are limited to Champaign County, but his interesting chapter on mammal succession is applicable probably to a much wider region. Necker & Hatfield and Mohr present the most recent information on the distribution of mammals throughout Illinois.

The economics of Illinois fur animals were not studied in the light of present conditions until Driver (1930) and Rasmussen (1931) compiled material on the yield and value of the fur resource for the Illinois Natural History Survey; some figures derived by these investigators were published in the *Blue Book of the State of Illinois* (Frison 1931, 1933). During the past few years, Mohr (1937, 1939) published information gathered from his study of Illinois trappers' reports. The Section of Fur Resources of the U. S. Department of Agriculture Bureau of Biological Survey (1939) and the U. S. Department of the Interior Fish and Wildlife Service (1940) published estimates of the total Illinois catch for several seasons which showed a range between 238,311 animals in the 1934-35 season to 996,998 animals in the 1938-39 season. The material on which these figures are based was gathered from several sources, including the Illinois State Department of Conservation and the Illinois Natural History Survey. The present study indicates that many of these figures are low.

PROJECT OBJECTIVES

Fur animals in Illinois, as in perhaps every other state, are of importance from viewpoints other than income. In one form or another there is nearly always the problem of predator control, which is brought up most frequently by farmers and sportsmen decrying real and alleged inroads of foxes, skunks and other carnivores on poultry and game birds. In Illinois, control is vigorously opposed by fox-hunting groups and to a lesser extent by central and southern orchardists, who appreciate the rodent- and insect-destroying habits of these animals. Sincere conservationists of certain convictions also oppose control. Illinois has little or no beaver damage, and no appreciable problem due to stock-killing coyotes. Wild dogs, sometimes reported as "wolves," are many times more destructive to domestic Illinois livestock than are coyotes. During recent years, members of coon-hunting* clubs, especially in the northern half of the state, have desired more sport and in some cases have supported movements designed to eliminate the raccoon from the trappers' list.

Perhaps the chief need for an impartial, fact-finding study lay in the necessity for providing reliable information on which to base theoretically sound, but still practical, fur laws. This need is particularly acute in Illinois due to the great north-south length of the state and the consequent appreciable variations in the dates of fur priming. Because of these variations, the state has wisely been divided into three zones, namely, northern, central and southern, fig. 1.

In the past, various regulations have marked the Illinois trapping season. The chief variations involve either staggered opening and closing dates for the three zones, staggered opening and closing dates for two or more important fur species, or both. The practice generally followed, that of staggering opening and closing dates for zones, is basically sound, the chief objection to it being the increased opportunity for some trappers to work southward through the three zones, taking a disproportionate share of the fur crop. The second variation—staggered opening and closing dates for species—induces a situation with which trappers, even those who most desire to be law abiding, cannot cope. In laws of this type, the muskrat season, because of the well-known delayed

*In this paper and the Mohr report, the words, *coon* and *possum* are sometimes used for *raccoon* and *opossum*, respectively. Both popular and literary usage seems to sanction the abbreviated forms of these words.

priming phenomenon characteristic of the species, is often postponed 15 to 30 days after the opening of the season on other animals. It likewise often extends the same length of time beyond the close of the season on other animals. In theory, the plan is good, and such a season will result in the taking of a larger percentage of more nearly prime muskrat furs. The impractical application comes from the impossibility of keeping muskrats out of mink sets during the first part of the season and minks out of muskrat sets during the last part of the season. Many minks and muskrats are drowned after being caught, and drowning is one of the best of all trapping techniques since it largely eliminates the escape of captured animals and is desirable from the humane standpoint. When animals are unavoidably taken illegally during staggered seasons, trappers are faced with the unfortunate alternatives of destroying or pelting valuable furs. Even if such animals are not drowned, and later escape or are released, they may die of injuries or, in the event of recovery, be in a condition too poor to breed.

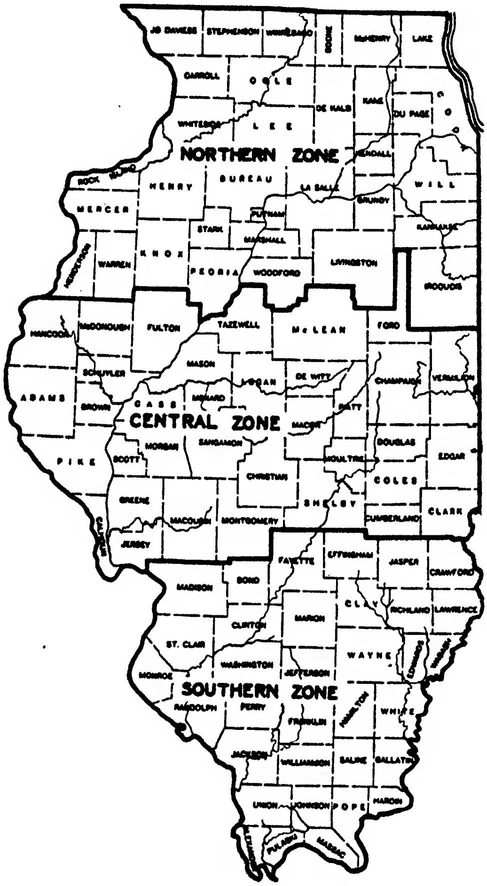

Fig. 1.—Map of Illinois showing the three zones applicable to the game and fish codes of the state.

Prior to the initiation of project 1-R, it was known that certain fur species in Illinois, especially raccoons, were reaching low population levels in many localities. In view of this situation, there was agitation for a completely closed season, a reduced season, bag limits, elimination of all raccoon trapping and various other measures, received mainly from sincere and well-meaning groups or individuals. In the absence of reliable and scientific information, it was impossible to act with full intelligence on these suggestions or to set fur trapping and hunting seasons fair both to the resource and to the appreciable number of people partly supported by it.

The general objectives of the survey, restated from the Preliminary Project Statement for 1-R, included information on the following points as they pertained to Illinois:

1. Annual yield of pelts by species.
2. Annual income of fur-takers from the fur resource.
3. Methods of trapping, hunting and marketing furs.
4. Percentage of furs taken by trappers and hunters, respectively.
5. Number of unlicensed fur-takers.
6. Fur animal cycles.

Information derived was to serve as a basis for recommending sound fur animal laws and offering suggestions for practical fur animal management.

SURVEY PROCEDURE

In the attainment of the fur survey's objectives, limitations of time and personnel necessarily affected procedure. Only one full-time man for a 13-month period was available for the work. Since it was desired to include the entire state in the survey, full coverage, even of sample counties, was precluded. It became necessary, therefore, to devise a sampling procedure that permitted rapid coverage, yet one yielding reliable data of a quantitative nature. This involved two general steps: the division of the state into fur survey

regions, and the separate sampling of each regional area.

Fur Survey Regions

A number of factors, rather than soil alone, were used as criteria in dividing Illinois into regions suitable to the purposes of this survey. These criteria, in their order of importance, were as follows: (1) soil, (2) forest cover, (3) drainage, (4) topography, (5) fur animal distribution, (6) agricultural use and (7) latitude.

On the basis of the above criteria, the state was divided into the eight regions listed in table 1 and shown in fig. 2. For purposes of accurate area calculation, the dividing lines between all regions were run north-south or east-west, and therefore only approximate the true boundaries. The area of each region is given in table 1. Various soil, drainage, topographic and cover maps were studied as an aid in defining the boundaries of areas over which uniform fur yields might be expected, figs. 3 and 4.

Although recognized as a prairie state, Illinois is more or less diversified in soil, climate, topography and agriculture. The southern one-third is relatively rough and hilly, climaxed geologically by the eastern extension of the unglaciated Ozarkian uplift, fig. 3. The northwestern corner is also unglaciated and is somewhat broken and rolling. The erosional effects of the Mississippi River on the west, the Ohio and Wabash rivers on the south and east, and the Illinois River, extending southwesterly from Chicago nearly to St. Louis, lower the prairie status of the state and make for an appreciable area of river bottoms and bluffs. Three definite sand areas and several larger sandy-soil regions further diversify the soil types of the state.

Table 1.—Fur survey regions and data on field samples used in Illinois fur animal survey, 1938-39 and 1939-40.

Fur Survey Region	Area of Region, Square Miles	County Sampled	Area of County Sampled, Square Miles	Area of Sample, Square Miles	Per Cent of County Sampled	Per Cent of Region Sampled
Northwest Hills	821	Jo Daviess	623	79.50	12.76	9.68
Western Prairie	3,244	Hancock	765	109.75	14.33	3.38
River Bluffs and Bottoms	11,251	Calhoun Union	282 403 } 685	64.00 90.00 } 154.00	22.70 22.33 } 22.48	1.37
Northwestern Sand Prairie	4,526	Lee	724	108.00	14.92	2.39
Glacial Lakes	1,638	Lake	483	91.75	18.99	5.60
Black Prairie	16,462	Champaign	988	111.00	11.23	0.67
Central Sand Prairie	5,697	Mason	554	101.00	18.23	1.77
Gray Prairie	13,026	Franklin Jasper	445 508 } 953	117.00 90.00 } 207.00	26.29 17.72 } 21.72	1.59
Illinois	56,665	10	5,775	962.00	....	1.70

Illinois has a total area of 56,665 square miles, of which 622 are inland waters. The state ranks twenty-third in area and third in population. Seventy-five per cent of its boundary is water. Its length from north to south is 385 miles; its greatest east-west width is about 215 miles. For effect of latitude see "Project Objectives."

Physiographical features of Illinois were determined largely during the glacial epoch. The moraines throughout the northern half, the numerous kettle lakes in the Chicago region, the till and loess deposits, and the prairies are directly related to glacial advances and retreats. A brief description of the eight fur survey regions follows.

Northwest Hills.—This, one of the state's two unglaciated areas, is locally termed the "Little Switzerland of Illinois." It is very small, the fur survey

region for this area measuring only 821 square miles, fig. 2. The terrain is rolling to broken, figs. 5 and 25. The western boundary along the Mississippi River is of rugged limestone bluffs. The thick limestone formation here has impeded the de-

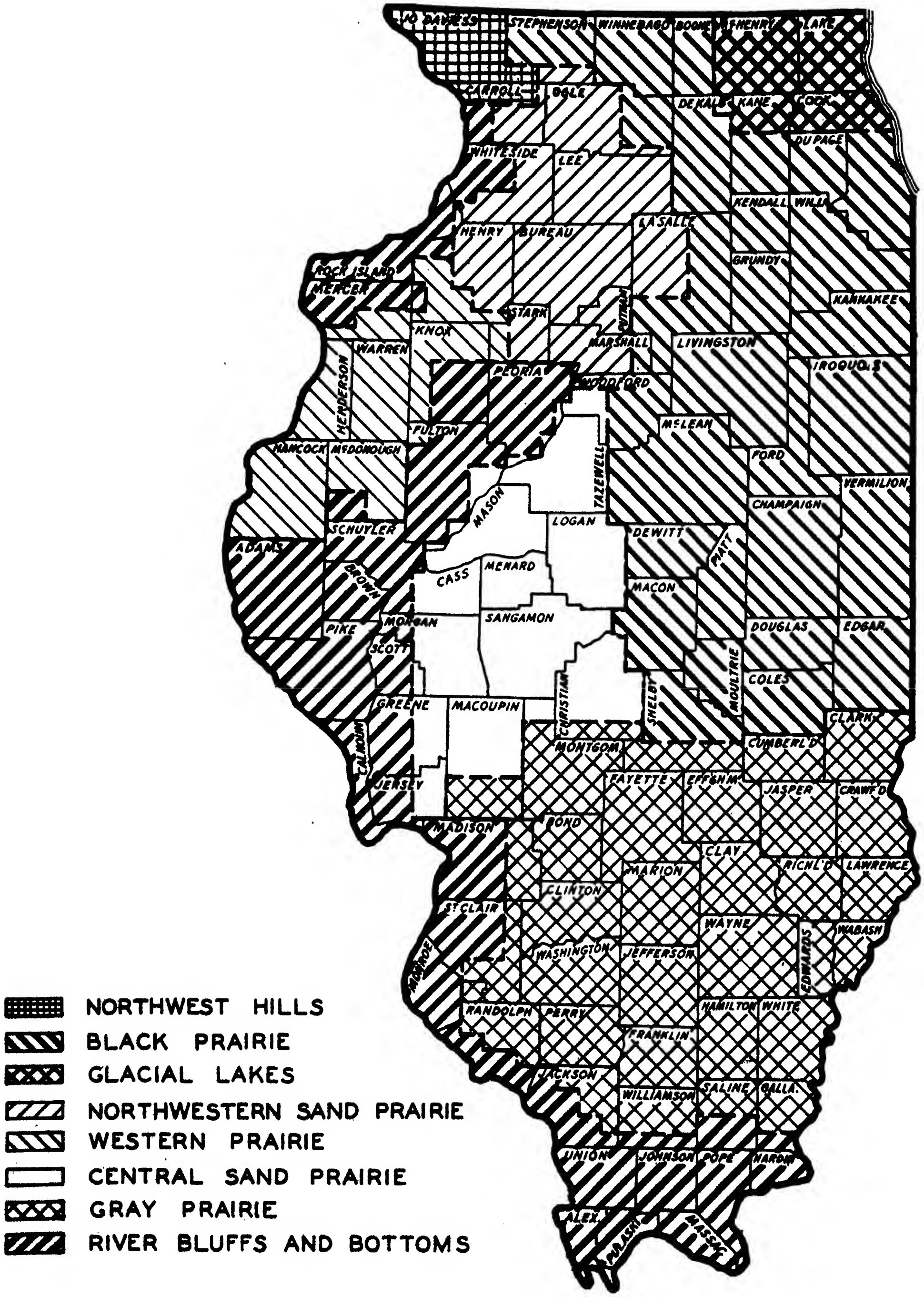

Fig. 2.—Map of Illinois showing the eight regions into which the state was divided for the purpose of making the fur resource survey. The River Bluffs and Bottoms Region is the only one that is not continuous.

velopment of extensive bottomlands. Scattered throughout are wooded limestone outcrops, frequently surrounded by bluegrass slopes. Although overgrazing is common, pasture management is fair in many instances. Cultivation is limited. Comparatively well vegetated soils release their waters slowly, giving rise to numerous small, clear streams. Deforestation has progressed somewhat less rapidly here than in most other places in Illinois, making for relatively good wildlife cover over much of the region.

Western Prairie.—This is a fertile, rather low prairie area of 3,244 square miles, fig. 2. The western border is the Mississippi River, along which there is local development of bluffs and bottomland. Here, the prairie seemingly flows into the river at many points. Streams are small, and enough of them are intermittent to impair the quality of otherwise good muskrat and mink habitats. Woody cover is generally lacking.

River Bluffs and Bottoms.—As a fur animal habitat this survey region, the only one not continuous, is perhaps the most interesting in the state, fig. 2. It contains 11,251 square miles, being exceeded in size only by the black prairie and gray prairie areas. This region, figs. 6, 18, 22, 24, 26, 27, 28, 29 and 30, determined largely on the bases of drainage and topography, contains three main subtypes characterized, respectively, by (1) three large rivers, all fluctuating in nature; (2) broken slopes or bluffs, which may be forested or partly cleared, and often pastured, leading down to bottomland; and (3) bottomland, timbered or cleared, often pastured and, in addition, often leveed. In all cases the bluffs are of limestone in varying stages of exposure and weathering. The region extends nearly the full north-south length of the state along the Mississippi River and through a number of counties along the southern half of the Illinois River. The heaviest population of raccoons, opossums and gray foxes in the state occurs in this region, as would be expected in a forested area. This large region, as a whole, shows a comparatively low muskrat yield, although some of the better muskrat marshes in the state occur along the middle Illinois River. Deforestation, leveeing, turbid and polluted water, and severely fluctuating water levels tend to impair the quality of the river bluffs and bottoms for fur animal occupancy.

Northwestern Sand Prairie.—This region is a rolling sand prairie, rather well interspersed with marsh, fig. 2. The

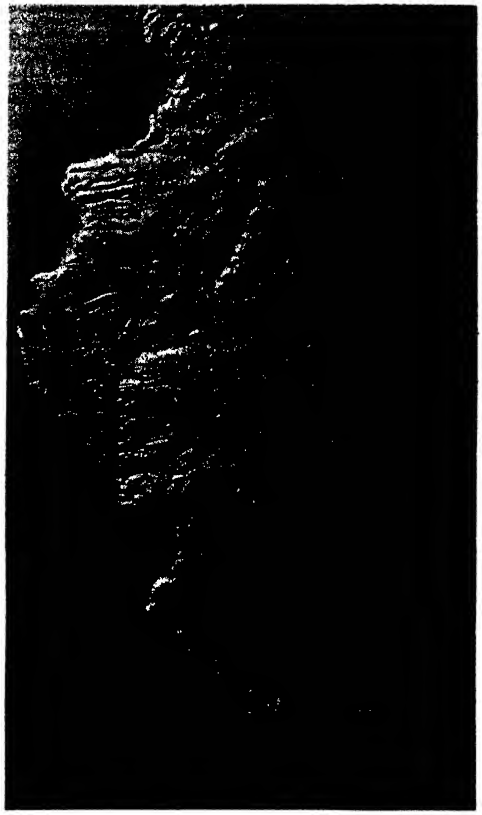

Fig. 3.—Relief map of Illinois showing main physical features of the state. (Print courtesy of the Illinois State Geological Survey.)

area is 4,526 square miles. Numerous small rivers, creeks and drainage ditches, many of which run the year around, add to the quality of the aquatic habitat. Lack of uniformity in physical features characterizes the region; areas of fertile black soil, limestone outcrops, marsh and sand ridges are the most common formations. The irregularity is due to deposits left by different periods of glaciation, and to sheet wash from melting ice masses. Sizable woodlands, chiefly of scrubby oak, supply some cover for raccoons. The Rock River, the largest stream within the northwestern part of the state, flows through the region. The valley of this river and that of the Green River are the main

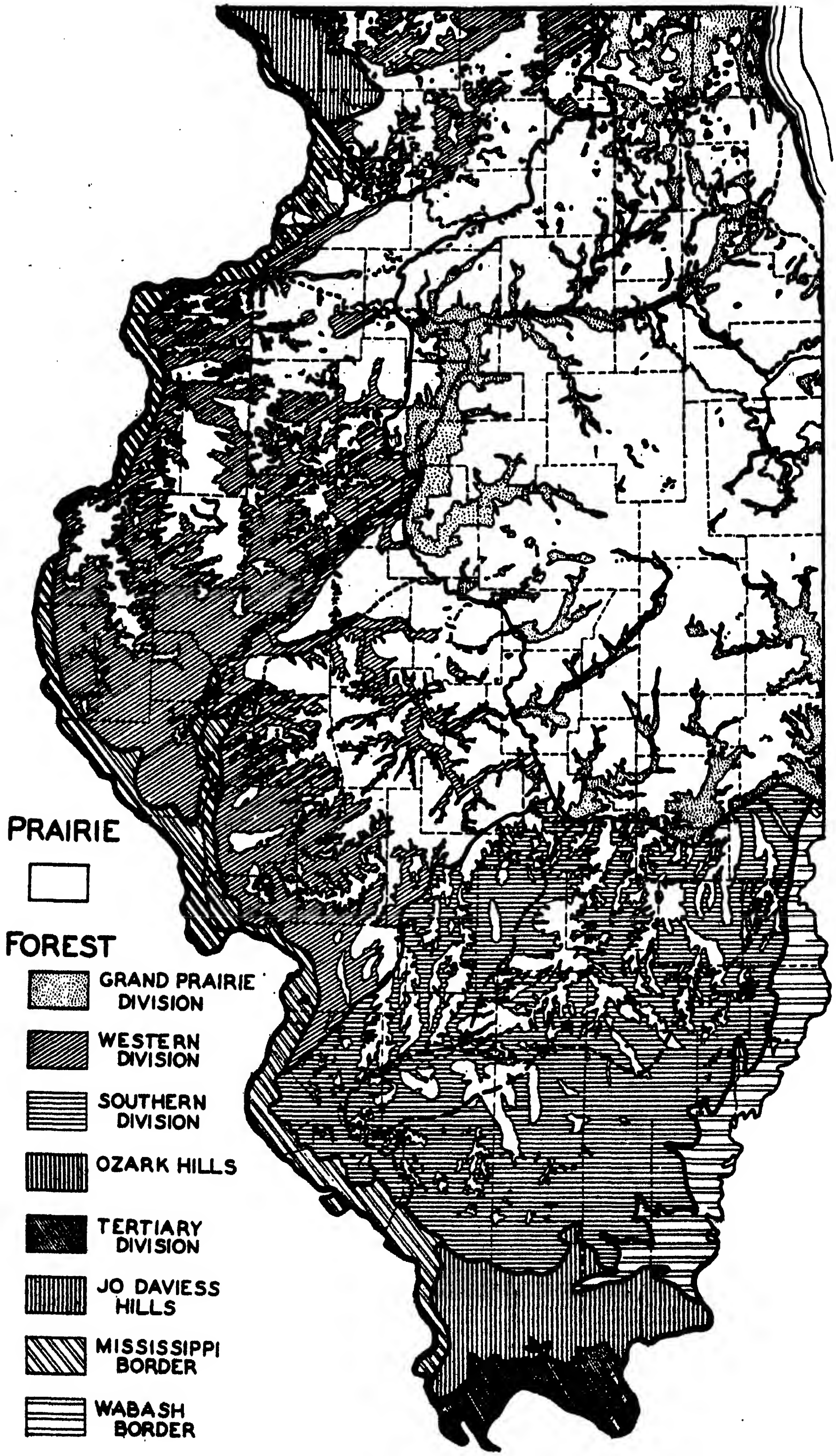

Fig. 4.—Vegetation map of Illinois. The shading, as shown in the key, indicates approximately the areas that were in forest early in the nineteenth century. (After map by Vestal 1931, based on map by Telford 1926.)

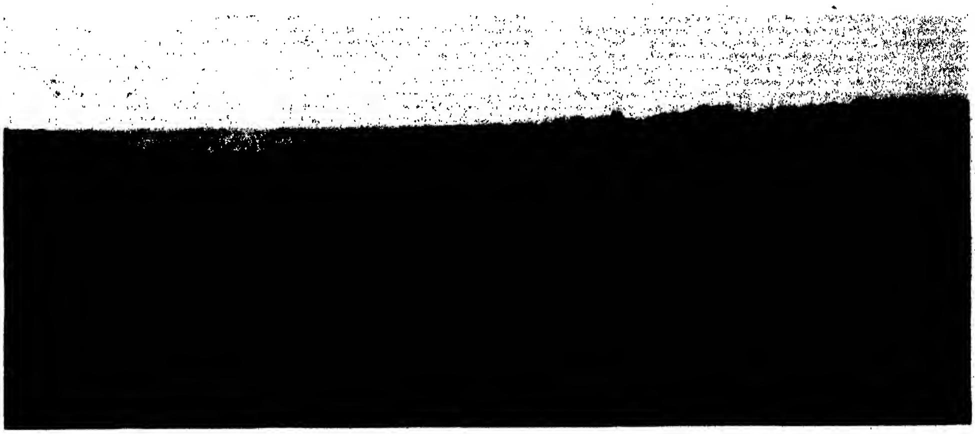

Fig. 5.—Northwest Hills habitat type. Forested hills, rolling terrain, permanent streams and absence of intensive agriculture make this region well adapted to skunks, gray foxes and badgers. A scene from Jo Daviess County is pictured here.

agricultural areas and in them are located most of the drainage ditches of the region.

Glacial Lakes.—In size, this is the second smallest of the eight survey regions, fig. 2. It contains only 1,638 square miles. Small glacial or kettle lakes are scattered rather uniformly over the entire area. Extensive cattail and bulrush marshes adjoin many of these lakes, forming excellent muskrat habitat, figs. 7 and 21. Varying amounts of emergent and floating vegetation in the lakes supplement the food supply. Water levels approach stability. The winters are usually severe. The topography is nearly level to rolling, and the soil is a heavy sandy loam. Woodland found in the region is mainly on estates; farmer-owned woodland is largely pastured.

Black Prairie.—The well-known Illinois black prairie is the most extensive general soil type in the state, fig. 2. The fur survey region set up for this soil type is 16,462 square miles in area. Streams, valleys and occasional moraines are the only deviations from its slightly rolling contour. Drainage ditches, fig. 8, and tile lines occur throughout the region, and most of the water from them enters the Illinois River system.

The ditches and some of the streams afford fair to good muskrat and mink

Fig. 6.—River Bluffs and Bottoms habitat type. Forest-inhabiting species such as raccoons, opossums and gray foxes occur in greater density here than in any other region in Illinois. The combination of aquatic and forest areas makes this region ideal raccoon range. Shown here is one of several connecting channels between the Illinois and Mississippi rivers, near Grafton.

Fig. 7.—The Glacial Lakes Region, which is characterized by abundant vegetation and extensive areas of shallow water, furnishes excellent muskrat range. Muskrat houses are built in shallower water than that shown in the photograph.

habitats. The original marsh has virtually disappeared, and most of the bottomland timber has been cut or so depleted of den trees as to afford little raccoon cover. Stripmines are fairly common on the black prairie. Muskrats and minks are the chief species benefited by the new biological habitat created by the stripping process in mining coal.

Central Sand Prairie.—With the exception that it has more upland sand deposits, fig. 9, this region, fig. 2, is very similar to the Northwestern Sand Prairie. It contains numerous hardwood timber stands on the sand knolls, which afford some cover for forest fur animals. The whole region is somewhat more rolling and is cut by more small stream valleys than the Northwestern Sand Prairie. The lower Sangamon River valley merges into the Illinois River bottoms characterized at this point by sizable areas of low, well-timbered land. The area is 5,697 square miles. Mixed farming, grazing and cattle feeding constitute its main agricultural activities.

Gray Prairie.—This southern Illinois type constitutes the second largest fur survey region, 13,026 square miles in area, fig. 2. The gray color of the soil, chiefly

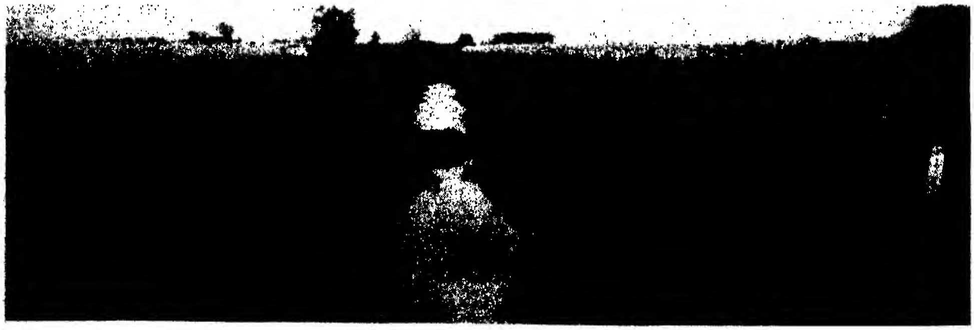

Fig. 8.—Black Prairie habitat type. Thousands of miles of ditches and ditchlike streams bordered by corn fields make for high muskrat yields in the Black Prairie Region.

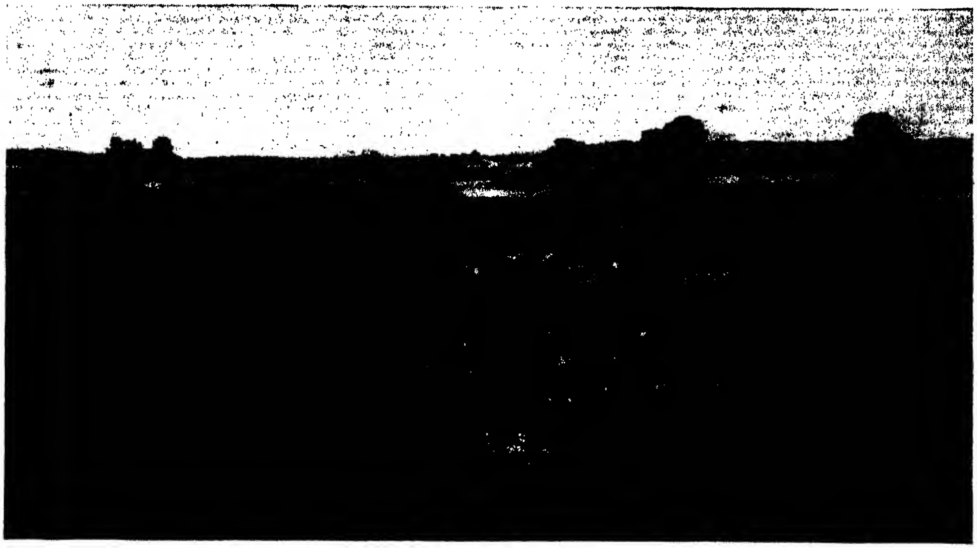

Fig. 9.—Sand Prairie habitat type, typical of several small regions in northern Illinois. Relatively unproductive soil and a general scarcity of marshes and streams account for the low fur yield for most species in the Central Sand Prairie Region.

loams and clays, suggests the name. Many of the larger and most of the smaller streams are intermittent. Rapid runoff, due to extensive clearing, a rolling topography and tight gumbo subsoils, is largely responsible for this condition. The largest river in the region, the Embarrass, was reduced to water holes during the fall of 1940. Much of the land is too poor for profitable farming, and a percentage unusual in Illinois has reverted to uncultivated fields and brushland, fig. 10. As

Fig. 10.—Gray Prairie habitat type. Characterized by good upland cover but a poor water supply, this type is comparatively low in fur production. Extensive woodland and non-intensive agriculture here favor most fur animals, but only a few permanent streams offer satisfactory range to such species as raccoons, minks and muskrats.

a result, the region affords considerable upland game cover, but the limited and undependable water supply greatly impairs the aquatic habitat. During recent years the Gray Prairie region has been exploited for coal, and at present it is being appreciably disturbed by an oil boom. Mine and oil residues are polluting some of the streams. Woodlots and larger timbered areas are scattered throughout the region.

Sampling Methods

For each of the fur survey regions one or two typical counties were selected as samples. In all, 10 sample counties were surveyed, fig. 11. The River Bluffs and Bottoms and the Gray Prairie regions were represented by two counties each. Across each county from three to nine strips, each 1 mile wide, were laid out in an east-west direction, and every household in this area was canvassed in gathering the sample data, fig. 12. From 11.23 to 22.48 per cent of the counties made up these samples, representing from 0.67 to 9.68 per cent of the total area of the regions and 1.70 per cent of the total area of the state. These data are given in detail in table 1.

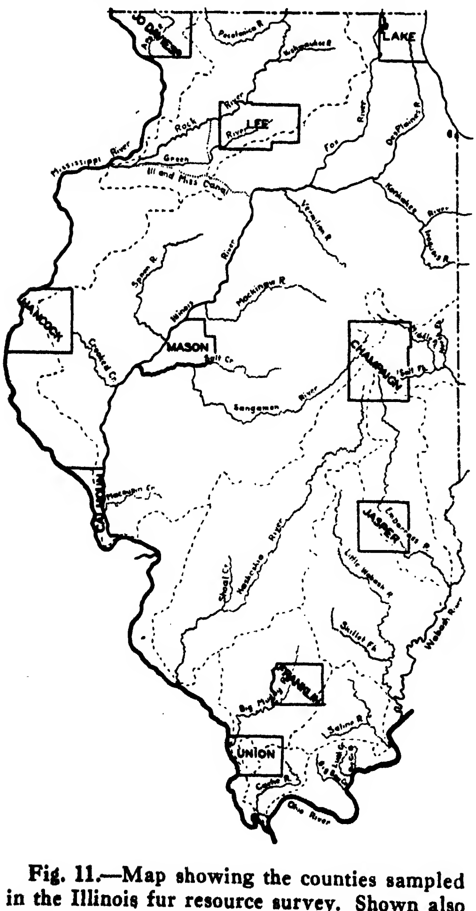

Fig. 11.—Map showing the counties sampled in the Illinois fur resource survey. Shown also are the main rivers and watersheds and divides (broken lines).

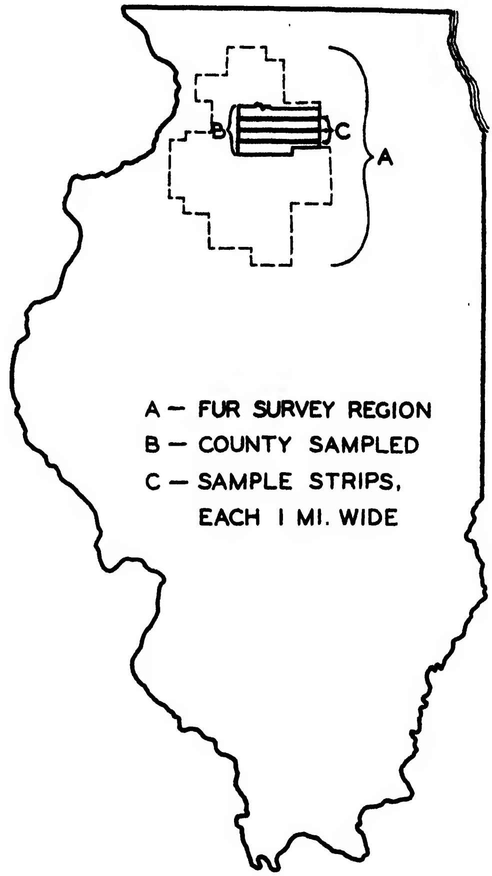

Fig. 12.—Map showing the relation of three sample strips and county to fur survey region. The position of Lee County is outlined.

The east-west direction of the strips tended to strike the streams at right angles, thus eliminating the error that would have resulted from following a stream or valley, comparatively productive of furs, for a long distance. In every case the strips extended the full east-west dimension of the county and insofar as physically possible were straight. County road maps were used to good advantage in establishing the strips and in locating residences or in re-

cording certain pertinent data. The number of strips per county was governed by its north-south dimension and the number of crossings required to give at least a 10 per cent sample. Except in Jo Daviess and Hancock counties, in which data for both years were obtained simultaneously in the spring of 1940, each strip was covered twice, once for the 1938-39 and once for the 1939-40 season.

As stated, every household covered by the strips was contacted, and with very few exceptions every resident admitting the taking of furs, or suspected of taking furs, was interviewed, and a record of his catch taken for both years of the survey.

ILLINOIS FUR ANIMAL RESOURCE SURVEY

FA-Illinois, Project 3-D

Individual Report

Season of__________ County__________No._______
Location____________________
Urban_________Rural________

Name________________________ Age___Address________________________
Main occupation____
Farm or landowner___Tenant___: Trapper__Hunter___: Day___Night______
Type of area hunted or trapped____
Approximate length of trapline___miles. Average no. traps used______
License: Fur___Hunting___: Reported 1938-39 catch on trapper annual form___Trapper monthly form___Hunter annual form___Didn't report______
Furs sold out of state___In state___Locally___To____________________
Object in taking fur: Hunting______Trapping______Total income______

Record of Catch for 1938-39

	Desire			Furs taken by			No. taken by week									No. dogs used	Fluctuation	Total no. pelts	XXXXX XXXXX XXXXX Since when
	more	less	none	Trapping	Hunting Day	Hunting Nite	1	2	3	4	5	6	7	8	9				
Muskrat																			
Opossum																			
Raccoon																			
Skunk																			
Mink																			
Red fox																			
Gray fox																			
Weasel																			
Coyote																			
Badger																			
H. cat																			
Wild cat																			
Civet																			
Gr. hog																			
Totals																			

General notes: ____

Fig. 13.—Field form used in the Illinois fur resource survey for recording data.

To contact many such individuals, numerous repeat trips were necessary, and much of the interviewing was done during evening hours and over week-ends. Every fur-taker, regardless of age, sex, trapping success or observance of laws, was questioned as adroitly as possible. Following each interview, all the information obtained was recorded on a form especially designed for this purpose, fig. 13. Questionable reports were corrected so far as possible by talking with neighbors, local fur dealers and state investigators (game wardens). In a very few cases, correction was accomplished by personal appraisal based on all information at hand.

Approximately 500 fur-takers, 50 dealers and several hundred other individuals were interviewed in obtaining data on the 1938-39 catch. With the exception of a few trappers or fur-hunters who moved on or off the strips between seasons, and the fur-takers in Jo Daviess and Hancock Counties, who were interviewed only once, the same individuals were contacted a second time when data on the season of 1939-40 were obtained. This duplication in sampling permitted an opportunity to evaluate the effects of price, weather and other seasonal changes on fur yield, refine sampling technique, and determine the trend in the fur catch over a 2-year period. It is probable that some individuals gave more nearly accurate answers the second year than the first.

As shown in fig. 13, the form used in recording field information included space for the fur-taker's name, address, license number, county and location of county. It included, also, space for the fur-taker's evaluation of the important fur animals, a point almost always conditioned by the monetary return; his opinion on whether these fur animals had increased or decreased in numbers since the preceding season; his estimate of trapping conditions, which, together with price, partly explain the seasonal fluctuation in catch; and the use made by the fur-taker of dog and gun in taking furs. The catch by species, whether this was the fur-taker's estimate or actual record, was always obtained and recorded on the form; the catch by weeks was usually estimated and gives only the general trend. Under "General notes," anything considered pertinent to the study or case at hand was written in by the questioner. The relationship of sample strips to one soil type region is illustrated in fig. 12.

In the two instances in which two counties represented a region, the data for both counties were averaged and considered as representative of the region as a whole. In these two instances, Union and Calhoun counties represented the River Bluffs and Bottoms Region, and Franklin and Jasper counties represented the Gray Prairie Region. In the first case, the average fur income per square mile during the 2-year period was $20.43 for Union County and $18.08 for Calhoun County; in the second the income during the same period was $11.71 for Jasper County and $10.48 for Franklin County, table 18. This close similarity of fur values for counties in the same regions indicates a relative uniformity throughout the regions, even though such similarity does not extend to each of the fur species. Since the

Table 2.—Chronological schedule of fur survey.

County	Season of 1938–39	Season of 1939–40
Champaign	June 1—June 24, 1939	May 31—June 11, 1940
Lake	June 27—July 14, 1939	May 15—May 28, 1940
Lee	July 15—Aug. 4, 1939	May 6—May 14, 1940
Mason	Aug. 6—Aug. 21, 1939	April 24—May 5, 1940
Jo Daviess	....	April 12—April 23, 1940
Hancock	....	March 28—April 11, 1940
Jasper	Aug. 23—Sept. 12, 1939	March 15—March 26, 1940
Franklin	Sept. 13—Sept. 29, 1939	March 3—March 14, 1940
Union	Sept. 30—Oct. 22, 1939	Feb. 16—March 2, 1940
Calhoun	Oct. 22—Nov. 14, 1939	Feb. 1—Feb. 15, 1940

River Bluffs and Bottoms and the Gray Prairie regions are among the largest and are the most diverse, it is believed that those regions represented by only one county were for most species reliably sampled.

The chronological summary of sampling, by counties, is shown in table 2.

It is apparent from table 2 that the survey of some counties required proportionally more time than others. The investigator acquired greater proficiency with experience. To a considerable degree differences in the time required were due to differences in this proficiency, but they are also accounted for by differences in the road systems in the 10 counties, by differences in the weather and in the season. In the farm planting and harvesting seasons, it was comparatively difficult to obtain information during working hours; accordingly, many persons were interviewed at night, on Sundays or at other times that suited the convenience of the persons questioned.

The desirable and undesirable features of the sampling method used in Project 1-R are evaluated as follows:

For

1. It is rapid, as compared to a complete survey or a survey involving a larger sample.
2. It does not require intensive knowledge of the sample area on the part of the investigator.
3. It is adaptable to the convenience of residents on the sample area.
4. If planned well, it gives relatively proportional sampling of all habitats.
5. It affords opportunity for the investigator to check reports of doubtful nature by talking to a neighbor or to a local fur-buyer.
6. It is more nearly representative of the total fur-taker situation, and less selective, than a survey based on catch reports of only licensed fur-takers.

Against

1. Use of roads as strip axes tends to intersect greatest human densities.
2. Sometimes it is impossible to run strips along a straight east-west or north-south course, thus interfering with the mechanical nature of the method.
3. Topography and water features of an area are not always adaptable to strip sampling.
4. Percentage of area required to give a true sample is not readily determined.
5. In coverage of a large unit, as a state, time limitation may make possible only a small sample, in this case, only 1.7 per cent of the area of the state.

THE FUR-TAKER

Fur-taker is a term used in this report to indicate any individual taking furs under natural conditions by his own efforts. It includes both trappers and hunters, whether they operated day or night, with or without dogs.

In table 3, data on the number and density of Illinois fur-takers are presented by regions. The density of fur-takers in the eight regions over the 2-year period ranges between 0.33 and 0.83 per square mile, the average for the state being 0.52 in 1938-39 and 0.48 in 1939-40. Fur-takers numbered 29,431 and 27,021, respectively, for the two seasons, as calculated from sample data. The importance of the River Bluffs and Bottoms, Black Prairie, Glacial Lakes and Gray Prairie regions are at once apparent, although for different reasons. The greatest density of fur-takers was in the Glacial Lakes Region, where numerous shallow lakes and marshes occur. The River Bluffs and Bottoms Region, with 0.72 fur-takers per square mile in 1938-39 and 0.63 in 1939-40, ranked second in density. This region, with 8,101 and 7,088 fur-takers for the two seasons, also ranked second in total number; it is third in size. The Black Prairie Region was first in total number of fur-takers, with 8,889 and 7,737, as well as largest in size. However, this region showed only 0.54 and 0.47 fur-takers per square mile.

Fur-hunters were by far the most numerous in the River Bluffs and Bottoms and the Gray Prairie regions; both contain considerable woodland and therefore are good raccoon and opossum habitats. Regions devoid of timber, figs. 2 and 4, ranked relatively low in the number of fur-hunters.

The above data disclose a statewide average of nearly one fur-taker for each 2 square miles.

It will be noted in table 3 that the summation of all trappers and fur-hunters exceeds the total given for fur-takers.

This is explained by the dual activities of some fur-takers who both hunted and trapped. A reduction from the 1938-39 figure of approximately 8 per cent in the total number of trappers and hunters in 1939-40 was due probably to local scarcity of furs as a result of drought and to better employment conditions in industry. the Illinois and Mississippi rivers, the lower Kaskaskia River, the Glacial Lakes Region, and the larger streams and marshes throughout the state. The calculated average annual income per fur-taker over the 2-year period was $42.58.

The number of fur-takers operating illegally in the years of the survey was

Table 3.—Number and density of Illinois fur-takers by regions, 1938-39 and 1939-40.

Fur Survey Region	Season	Trappers		Fur-Hunters		Fur-Takers*	
		Average Number of Trappers Per Square Mile	Calculated Number of Trappers	Average Number of Fur-Hunters Per Square Mile	Calculated Number of Fur-Hunters	Average Number of Fur-Takers Per Square Mile	Calculated Number of Fur-Takers
	1938–39	0.40	328	0.15	123	0.50	410
Northwest Hills...	1939–40	0.41	337	0.12	98	0.49	402
	1938–39	0.29	941	0.20	649	0.41	1,330
Western Prairie...	1939–40	0.36	1,168	0.26	843	0.47	1,525
River Bluffs and	1938–39	0.40	4,500	0.42	4,725	0.72	8,101
Bottoms........	1939–40	0.33	3,713	0.40	4,500	0.63	7,088
Northwestern	1938–39	0.49	2,218	0.11	498	0.56	2,535
Sand Prairie....	1939–40	0.46	2,082	0.10	453	0.51	2,308
	1938–39	0.82	1,343	0.02	33	0.83	1,360
Glacial Lakes.....	1939–40	0.71	1,163	0.03	49	0.73	1,196
	1938–39	0.52	8,560	0.05	823	0.54	8,889
Black Prairie.....	1939–40	0.46	7,573	0.02	329	0.47	7,737
Central	1938–39	0.39	2,222	0.12	684	0.44	2,507
Sand Prairie....	1939–40	0.39	2,222	0.11	627	0.41	2,336
	1938–39	0.23	2,996	0.17	2,214	0.33	4,299
Gray Prairie......	1939–40	0.22	2,866	0.19	2,475	0.34	4,429
	1938–39	0.408	23,108	0.172	9,749	0.52	29,431
Illinois...........	1939–40	0.373	21,124	0.165	9,374	0.48	27,021

*The total number of fur-takers is lower than the sum of trappers and fur-hunters because some individuals were listed as both trappers and fur-hunters.

The survey brought out the surprising fact that most of the fur-takers in Illinois are men, who trap a very large proportion of the annual fur crop; schoolboy trappers are distinctly in the minority. The average age of fur-takers contacted was 33 years; the oldest was 74 and the youngest 11. The main reason for the relatively small number of boy trappers is the highly developed Illinois school system, which has enrolled almost all rural youths. Hours which schoolboys formerly spent on traplines are now spent in riding to and from town or in participating in high school activities. Professional trappers, averaging at least middle age, dominate all of the best trapping grounds, such as those along

difficult to determine. In some localities probably as high as 10 per cent of them were serious violators of the game code, while in other places practically all operated within the law.

Pertinent data on the calculated number of trappers and the number of trappers' licenses sold in Illinois are summarized for the period covered by the survey in table 4.

Study of table 4 discloses for 1938-39 an obvious discrepancy between the number of licenses sold by the State Department of Conservation and the number of licensed fur-takers, as calculated from figures derived from the survey. Since the Illinois law in both seasons covered by this

report required each fur-taker not residing on the land on which he operated to purchase a license for each unit of 25 traps, obviously the calculated number of licensed fur-takers should have been smaller than the number of licenses sold. Such was the case in 1939-40. But in 1938-39 the number of fur-takers, as calculated from interviews, was greater than the number of licenses sold.

This discrepancy may be due to (1) inadequate sampling in the state, wherein only 1.7 per cent of the total area was actually covered, (2) disproportionate sampling as between rural and urban communities (the percentage of trappers required to purchase licenses is relatively low in rural communities and high in urban communities) and (3) inaccurate statements by the fur-takers interviewed.

Figures calculated from interviews with fur-takers, if accepted at their face value, would indicate that license holders constituted 54 per cent of the total number of fur-takers for 1938-39 and 59 per cent for 1939-40. But, as the figure 15,820 for the calculated number of licensed fur-takers for 1938-39 is obviously inaccurate, the percentage derived for this season cannot be considered valid.

Using the data contained in fur-takers' monthly reports, Mohr calculated that the number of licensed fur-takers was 12,810 in 1938-39 and 16,615 in 1939-40, table 4. Data contained in table 1 of the Mohr report indicate that 44 per cent of the fur-takers were licensed in 1938-39 and 61 per cent in 1939-40.

The percentages for 1939-40 from the present and the Mohr reports must be considered surprisingly close in view of differences in methods of investigation. Despite wide differences in the figures from the two reports for 1938-39, the percentages for the two seasons derived from these reports reinforce each other in indicating a greater percentage of licensed fur-takers for the second season than the first.

Table 4.—Fur-takers' licenses sold by the State Department of Conservation, the total number of fur-takers (calculated from data gathered from interviews with fur-takers) and the number of licensed fur-takers (calculated from interviews and from monthly reports to the Department of Conservation), 1938-39 and 1939-40, in Illinois.

Season	Number of Licenses Sold	Total Number of Fur-Takers, Calculated From Interviews With Fur-Takers	Licensed Fur-Takers, Calculated From Interviews With Fur-Takers		Licensed Fur-Takers, Calculated From Fur-Takers' Monthly Reports		Calculated Number of Licenses Per Fur-Taker†
			Number	Per Cent of Total Number of Fur-Takers	Number*	Per Cent of Total Number of Fur-Takers	
1938–39....	15,472	29,431	15,820	54	12,810	44	1.2
1939–40....	18,277	27,021	15,982	59	16,615	61	1.1

*Derived by Mohr and contained in table 1 of the Mohr report, published herewith as Article 6.
†Calculated by Mohr by determining the number of reporting licensees and dividing the number of licenses sold thereto by the number of licensees.

ILLINOIS FUR LAWS

During the period covered by this survey, 1938-39 and 1939-40, Illinois statutes did not require the purchase of a trapping license by the fur-taker operating on the land on which he resided if he used 25 or fewer traps; however, if the fur-taker used more than 25 traps he was required to purchase a trapping license for each unit of 25 traps or fraction thereof in excess of the 25 to which residence on the land entitled him. For all other fur-takers, both hunters and trappers, the law required the purchase of one license for each 25 or fewer traps at a cost of $2 for a resident and $10 for a non-resident of Illinois. These fees included the cost of

tags, which were supplied by the State Department of Conservation, and one of which was required to be attached to each trap. In the season of 1939-40, even the trapper exempt from the license regulation was required to tag his traps as specified above, tags being supplied by the Department at cost of production.

The trapping season of 1938-39 was staggered both by zones and by species. In all zones, and for all protected furbearing species on which an open season was provided except muskrats and foxes, it opened Nov. 15, but closed Jan. 15 in the southern and central zones and Jan. 31 in the northern zone. The muskrat season opened Nov. 15 in the northern zone, but not until Dec. 1 in the central and southern zones. It closed Jan. 31 in all zones, 16 days later than the season on most other species in the two more southern zones. Only in the northern zone did the muskrat season coincide with open dates for other protected fur animals. Foxes, in the northern and central zones, were unprotected by a closed season; in the southern zone they were included in the open season with most other fur species. Certain northern counties paid a bounty on foxes. No distinction was made between red and gray foxes. No limits were placed on the take of any furbearer on which an open season was declared. Muskrats could be taken only with traps, and no trap could be set within 10 feet of a muskrat house or den. Dog training was permitted during the period of Aug. 15 to March 31.

In 1939-40, there was no staggering of seasons by species. The trapping season began Nov. 15 in the northern and central zones and closed Jan. 31 in the former and Jan. 15 in the latter. In the southern and central zones, the fox season coincided with that of other fur-bearing animals. In the northern zone, there was no closed season on foxes.

The codes applicable to the two seasons covered by the survey provided for monthly catch reports from all persons, licensed and unlicensed, taking fur animals, but survey calculations indicated that only 4,105 fur-takers, or 26 per cent of the calculated 15,820 licensed, made these reports in 1938-39, and only 2,144, or 13 per cent of the calculated 15,982 licensed, made these reports in 1939-40. In 1939-40 a difficulty arose in the distribution of the blank forms, which is believed to explain the difference for the 2 years.

ILLINOIS FUR ANIMALS

The income from the sale of Illinois raw furs, estimated to vary between 1 and 2 million dollars annually, is derived with little direct investment and in the almost complete absence of management. This income is distinctive in that it is distributed to every county in the state, chiefly among people most in need of additional funds. The main cost is the time required to harvest the crop, which is limited chiefly to the rural and small town populations. The trapping season fits into the slack part of the year and provides a timely source of cash during the winter months, especially the holiday period.

The following discussions of the yield and value of Illinois furs are presented by species, and constitute the bulk of this report. No attempt to include habits or life histories has been made. With each specific discussion is included a tabulated summary of field data, which supplies the basis for the discussion.

The average fur prices received by furtakers were found by averaging a large series of pelts for each species from each region. The average prices thus determined are given in table 5.

At the time of the survey, a number of Illinois furbearers occurred in such thin populations or were restricted to so small a part of the state that the sampling methods used were inadequate in evaluat-

Table 5.—Average prices received by furtakers for Illinois raw furs, 1938-39 and 1939-40 (to nearest $0.05).

Species	Average Price for Season 1938–39	Average Price for Season 1939–40
Muskrat....	$0.80	$1.00
Opossum....	0.20	0.20
Raccoon....	2.00	2.00
Skunk.	0.75	1.00
Mink....	7.00	6.00
Red fox..	3.00	2.75
Gray fox.	1.75	1.75
Weasel...	0.35	0.35
Coyote...	2.00	2.00

ing their status. These species are the badger, coyote, otter, beaver and bobcat. The house cat, abundant in every community, is of little importance in the fur trade. In several instances, especially for the otter, beaver and bobcat, the survey was supplemented by special investigation by the senior author and others.

Muskrat*

The muskrat, taken in all Illinois counties and common to practically all northern and many southern aquatic habitats in the state, represented over 68 per cent of the calculated total fur catch for the two seasons of the survey, table 20. For the season of 1938-39, the calculated catch was 884,395 muskrats, worth $707,456; and for 1939-40, it was 664,831 muskrats, worth $664,831, table 6. Muskrat furs, therefore, represented a sizable business, centered mainly in the northern half of Illinois and operated for the most part by older, experienced trappers. Income is practically the sole incentive for taking muskrats, whereas with several other Illinois furbearers sport is partly responsible for the take. The state's muskrat crop, although largely unmanaged and indiscriminately harvested, continues to provide all or part of the winter livelihood of 20,000 or more persons, many of whom are heads of families.

In Illinois, the muskrat has demonstrated marked ability to withstand trapping and environmental losses, probably because of its high reproductive potential. Simple management practices would undoubtedly result in a greater return from muskrats.

Popularity.—Among Illinois fur-takers the muskrat was the third most popular and sought-for species. In 1938-39, 312 of the trappers questioned desired more and 7 fewer; in 1939-40, 326 wanted more and 2 wanted fewer. Only the raccoon and mink were more highly regarded. A number of reasons account for the muskrat's popularity, chief of which are relative abundance, ease of trapping and handling, and the comparative value of the fur.

Damage and Control.—The total of 9 fur-takers who opposed an increase in the muskrat population were motivated by damage done in some instances to cornfields, ditches and tiles. Loss from such damage may be appreciable, especially where the destruction of dams and plugging of ditches is involved. Errington (1938) has shown that income from muskrat pelts outweighs the damage done by the animals to crops, including value of labor and equipment. An annual fur income of approximately $30 per mile of ditch was reported (Yeager 1943*b*) in Champaign County; more than 90 per cent of this was derived from muskrats. Four farmer-trappers in Champaign County in 1938-39 took 634 muskrats from 8 miles of drainage ditches. The pelts were worth $507.20, or $63.40 per linear mile. This income is in excess of the value of any damage incurred. The ditches involved were better than average as muskrat habitat, but crop damage is generally proportional to muskrat density, and other ditches would show both a lower degree of damage and a lower fur income. In any case, the fur income could be expected to exceed the value of crop losses.

In the Black Prairie and to a lesser degree in the Northwestern Sand Prairie, farmers who trap or lease trapping rights consider the loss of corn due to muskrat damage a part of the cost in producing the fur crop. Farmers who see the loss in the light of a needless waste make more or less effective efforts to keep their ditches free of muskrats.

The control of muskrats under conditions where their presence is definitely destructive is not well discussed by any one writer. Dams can be protected by covering them with galvanized poultry wire of 1-inch mesh, or, in some cases, damage can be prevented by building the dams with slopes so slight that burrowing is discouraged. A slope of at least 7 or 8 to 1 is necessary to discourage burrowing, and is, of course, impractical in most instances. Ditches can be protected by leaving an uncultivated strip 8 or 10 feet wide along each side. Planted to shrubs and unpastured, such strips make excellent game coverts in addition to being resistant to caving such as is sometimes caused by muskrat burrows. Ditches with sides sloped at the time of construction are resistant to caving. The writers believe that the most practical control is trapping during the open season, the amount of

*The scientific names of fur animals mentioned in this paper are listed facing the contents page.

Table 6.—Muskrat in Illinois: Calculated catch, income, trapping and hunting data, fluctuation in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Muskrats	Per Cent of Hunters Taking Muskrats	Per Cent Taken By: Trappers	Per Cent Taken By: Hunters	Number of Fur-Takers Reporting on Muskrat Populations: Increase	No Change	Decrease	Number of Fur-Takers Desiring: More Muskrats	Fewer Muskrats
Northwest Hills	1938–39	8,859	10.79	$ 7,087.20	$8.63	88	0	100	0	3	10	15	29	0
	1939–40	11,584	14.11	11,584.00	14.11	85	0	100	0	15	4	10	28	0
Western Prairie	1938–39	15,539	4.79	12,431.20	3.83	75	0	100	0	1	7	18	28	1
	1939–40	18,733	5.79	18,783.00	5.79	73	0	100	0	6	7	19	34	1
River Bluffs and Bottoms	1938–39	25,950	2.31	20,782.00	1.85	48	0	100	0	2	12	15	38	1
	1939–40	20,927	1.86	20,927.00	1.86	50	0	100	0	1	2	37	19	0
Northwestern Sand Prairie	1938–39	110,389	24.39	88,311.20	19.51	85	0	100	0	23	5	15	38	1
	1939–40	115,594	25.54	115,594.00	25.54	100	0	100	0	25	5	9	40	0
Glacial Lakes	1938–39	97,346	59.43	77,876.80	47.54	96	0	100	0	18	9	33	50	0
	1939–40	71,826	43.85	71,826.00	43.85	98	0	100	0	12	12	36	62	0
Black Prairie	1938–39	464,722	28.23	371,777.60	22.58	96	0	100	0	20	6	20	42	3
	1939–40	304,712	18.51	304,712.00	18.51	100	0	100	0	12	12	29	44	1
Central Sand Prairie	1938–39	113,484	19.92	90,737.20	15.94	97	0	100	0	2	12	21	37	1
	1939–40	89,101	15.64	89,101.00	15.64	95	0	100	0	5	5	19	36	0
Gray Prairie	1938–39	48,066	3.69	38,452.80	2.95	83	0	100	0	4	2	36	50	0
	1939–40	32,304	2.48	32,304.00	2.48	83	0	100	0	2	2	48	63	0
Illinois	1938–39	884,395	15.61	$707,456.00	$12.48	84	0	100	0	73	63	173	312	7
	1939–40	664,831	11.73	$664,831.00	$11.73	84	0	100	0	78	49	207	326	2

trapping being regulated according to the degree of control needed. Usually, the services of skillful trappers can be enlisted.

Populations.—Of 643 trappers expressing an opinion relative to changes in muskrat population, for the season of 1938-39, 173 indicated a decrease, 63 no change and 73 an increase as compared with the preceding season; for the season of 1939-40, 207 trappers reported a decrease, 49 no change and 78 an increase as compared with the preceding season. Many of the older, experienced trappers were able to recall fluctuations for the 5-year period preceding this study. Nearly all of these individuals agreed that a general population decline had occurred; this decline appeared to be less rapid in the northern third than in other parts of the state.

Local muskrat populations were found to vary widely in density, a condition making unreliable the use of restricted observations as criteria for statewide trends. Weather has a highly important bearing on muskrat catches, reproduction and dispersal (Errington 1937*b*, 1939, 1940). For example, the 1938-39 muskrat catch in Illinois was, according to numerous experienced trappers, lower than that of the preceding year, a drop believed to have been due in part to heavy floods at a time destructive to new-born litters. The decrease in the 1939-40 catch, which was not experienced in 17 northwestern counties, is believed to have been due mainly to drought over most of the state during the late summer and fall of 1939. Lack of water forced many animals to migrate, and consequently exposed them more than usual to predation. The northwestern corner of the state, in contrast, experienced normal weather during the spring, summer and fall, and a moist open season, conducive to effective trapping. Because of normal young-rearing and harvesting, a normal crop was taken there.

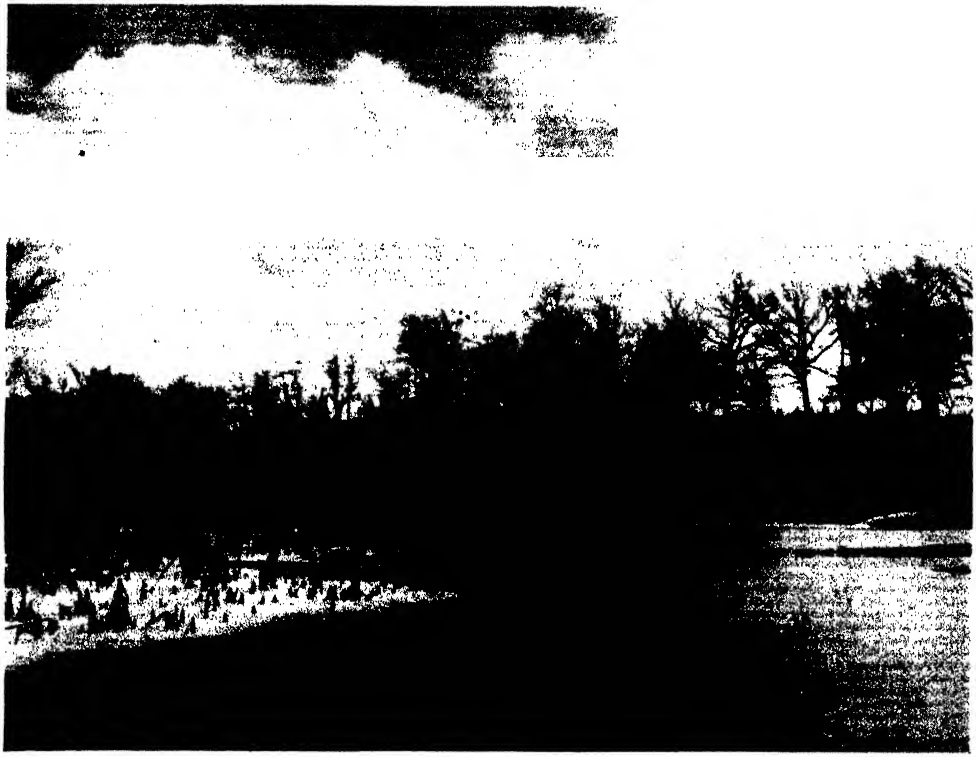

Fig. 14.—A spring-run type of marsh, highly productive of muskrats, Vermilion County. This marsh, less than 2 acres, annually produces 20 to 40 muskrats.

The writers believe that, except for the possible but unknown effect of cycles, the following factors are chiefly responsible

for the recent decline in muskrat numbers, which is associated with reduced range.

1. Overtrapping, arising from demand for muskrat furs and resulting in insufficient breeding stock.

2. Drainage of potential agricultural land, greatly reducing the aquatic habitat.

3. Shortage of food, due to grazing, burning and clearing land.

4. Predation, resulting largely from exposure of the animals during enforced migration in search of water, and from a shortage of food and cover along streams and ditches.

Fig. 15.—Three entrances to muskrat den in flooded stump, exposed by sudden drop in water level, Illinois River, Calhoun County. Muskrats may dig new tunnels to correspond with changes in water level.

Habitats.—In Illinois, as elsewhere, trappers make a distinction between marsh and bank muskrats. Marsh muskrats, except along levees and banks, build houses of cattails, bulrushes, water smartweed and similar materials; bank muskrats simply tunnel runways, beginning under water and ending above water. The marsh animals are found principally in the northern half of the state, and along the Mississippi and Illinois rivers, fig. 7 and frontispiece. Bank muskrats inhabit drainage ditches, ponds and streams throughout Illinois, fig. 8. In general, it appears that muskrats build houses if possible. Even in stripmine areas, where conditions favor bank dens, muskrats build an occasional house of cattail or other vegetation where its occurrence is abundant enough and the area of shallow water large enough for the purpose (Yeager 1942).

In the two seasons covered by this study, the greatest production of marsh muskrats came from the Glacial Lakes Region; the yield in this area averaged about 50 per square mile. The Northwestern Sand Prairie produced about 25 per square mile, the Central Sand Prairie about 18 per square mile, table 6.

Marsh muskrats occupy an environment which, under ideal conditions, is favored by relatively stable water levels and an abundance of vegetation (*Typhia, Scirpus, Polygonum* and *Potamogeton*), fig. 14. Although the bank habitat is generally less favorable than the marsh habitat, the total catch of bank muskrats in Illinois exceeds that of the marsh animals. This is due to the much larger range inhabited by bank-dwelling animals, centering in the Black Prairie where streams and drainage ditches afford extensive bank habitations.

Muskrats show excellent adaptability to the changes and perversities of environment, fig. 15. Food shortage, drought and flood occasionally decimate their numbers or force migration, but seldom extirpate them from a given stream or pond. Throughout the Black Prairie, thousands of shallow-water ditches offer, in normal seasons, habitats with sufficient food, water and cover, fig. 8. During wet years these ditches provide excellent range. The catch varies by years, apparently according to weather conditions. In 1938-39 the total muskrat catch in the Black Prairie Region averaged 28.23 per square mile; in 1939-40, which was very dry over most of the region, the catch was only 18.51 per square mile.

Muskrat habitats in the Gray Prairie, the River Bluffs and Bottoms and the Western Prairie regions have low carrying capacities. The intermittent character of the streams and general deficiency of aquatic vegetation, as well as heavy trapping, explain the comparatively low catch of about two to five animals per square mile, table 6.

The quality or type of the habitat has considerable effect on the more obvious food habits of muskrats. The utilization of such items as willow, cottonwood, fish, mollusks and crustaceans seems to be more common among stream than among marsh muskrats, perhaps because of a shortage of cattails, bulrushes and similar vegeta-

tion in the streams. During the survey, this difference in food habits was frequently commented upon by veteran trappers.

Food, in turn, apparently has a considerable effect on fur quality. Stream muskrats, probably because of a deficiency of quality foods, and possibly because of food shortage, yield pelts known to trappers and to the fur trade as "papery." The leather of these pelts is thin, the hair color is a lighter brown and the fur is neither so long nor so thick as that of marsh muskrats. Fur buyers commonly pay 10 to 20 per cent more for marsh or ditch-grown pelts than for "papery" skins.

Water contaminated with oil sludge or residues from coal mines destroys plant life, thus reducing habitat quality. Also, it is frequently noticed that muskrats may be scarce along, or absent from, streams contaminated by mine wastes, and from both streams and ditches subject to heavy grazing, fig. 16. Pollution has damaged to varying degrees the muskrat habitat along the Rock, Galena and upper Illinois rivers and around the centers of oil activity throughout the Gray Prairie Region.

Trapping.—The Illinois Game Code in effect for the 2 years beginning July 1, 1939, limited the taking of muskrats to spring traps having a jaw spread of not over 6 inches. The 1937 code did not limit the size of jaw. The codes put into effect in both these years specified that a trap might not be set or placed within 10 feet of any muskrat house or den, but trapping nearer than this distance was found to be a common practice. There was no limitation of take in any of the three zones in either year of the survey. Spearing and shooting of muskrats were properly illegal, but, as the regulation respecting these methods of kill is difficult to enforce, some muskrats were so taken in both 1938-39 and 1939-40. Because their numbers could not be ascertained, they were not considered in the data.

Water sets, unbaited or "blind," are the standard with Illinois muskrat trappers. Traps are placed in runs at the entrance of holes, dens or houses, on logs, stumps or floating chunks, and at feed beds. Usually some provision is made for drowning the animals, in order to reduce the percentage of escapes effected by wringing off a foot. The staking of traps in or toward deep water and the use of large, heavy traps are the most common

Fig. 16.—Grazed ditch with eroding banks, Champaign County. Such waterways produce little muskrat food; burrows are often destroyed by stock.

methods of assuring drowning. Killer type traps are seldom used in Illinois, even on open marshes. Under-ice trapping is common in the Glacial Lakes Region and in the Illiniois River marshes. Many trappers favor ice trapping, since it enables them to define used runs more easily, and "wring-offs" are practically eliminated. In under-ice operation, traps are simply set in muskrat runs through holes chopped in the ice and staked by driving a willow or buttonwood branch through the ring at the end of the trap chain. The traps are seldom weighted or covered. Similar sets are used in trapping bank muskrats, except for the "run" method employed in the marshes, which is impossible under bank conditions.

Fluctuating water levels are the bane of both marsh and stream trappers. A change of only a few inches in the level, either up or down, may throw an entire trapline out of order. The increased diversion of water, December, 1940, from Lake Michigan into the Illinois River was followed by numerous complaints by trappers whose traps in some instances were so deeply covered that catches were impossible. Traps replaced were later left on dry ground. In meeting the problem of fluctuating water in streams, some trappers anchor logs, boards or other floating debris with wire in such manner that these rise and fall with the water. Traps set thereon, unless rendered inoperative by freezing, are always in working order and are in excellent locations.

A very large percentage of the annual muskrat catch is taken during the first few weeks of the season. As much as 50 to 85 per cent may be caught during the first 15 nights. It is well known that muskrat furs are not prime until December 1 or after, and that the best skins are taken in January and February. The facts that the muskrat is by far the most important species and that a large portion of the catch is made during the first part of the season furnish good arguments in favor of a trapping season opening on Dec. 1.

The value of the muskrat resource is such that the annual harvest of furs is taking on an organized form, wherein the leasing of grounds or trapping rights has become common. During the years of the survey, this leasing system prevailed along the large river marshes, the glacial lakes marshes and the hundreds of drainage ditches throughout the Black Prairie Region. Some of the best ditches in this region were leased at $20 per linear mile. In some cases, the rental was 50 per cent of the catch, the trapper furnishing all necessary supplies and labor. In the southern half of the state leasing of grounds was found to be less common.

A point of interest noted during the survey was the abundance of Norway or barn rats, *Rattus norvegicus* (Erxleben), reported taken in muskrat sets. In 1938-39, a Lee County trapper, using 30 traps, claimed to have taken 100 muskrats and 53 barn rats; another trapper in Lee County, using 25 traps, claimed to have caught 50 muskrats and 20 barn rats. Water sets were used exclusively in these instances, indicating that, if these claims are valid, barn rats are not reluctant to swim or wade in water up to depths of several inches. General complaints of barn rat abundance were received from trappers in Lee, Jasper and Champaign counties. In 1939-40 the same trappers reported fewer barn rat catches. Experienced trappers are of the opinion that these rats compete keenly with muskrats for food and territory, and that they are potential if not actual predators on muskrat young. It may be that some of the animals reported by trappers as barn rats were actually kit muskrats.

Management.—On the basis of the information at hand, the writers believe that the following steps would be effective in checking further depletion in muskrat range and numbers, thereby placing the species in a more secure position in Illinois.

1. Enact and enforce more effective laws against oil and mine pollution of water habitats.

2. Enact seasons opening Dec. 1 and closing Jan. 31 in all zones. This step would insure a higher average quality in muskrat fur and aid in preventing overtrapping during mild November weather. If prices are high, trappers will operate during the adverse weather of December and January.

3. Allow traps to be placed 3 feet instead of 10 feet from houses and dens. Trapping closer than 10 feet is a statewide practice; enforcement of the 10-foot regu-

lation provided under the law in force at the time of the survey is practically impossible.

4. Enforce more effectively regulations against spearing and shooting of muskrats.

Opossum

The opossum, fig. 17, is taken in every Illinois county, but occurs in comparatively small numbers in the northern part of the state. For the season of 1938-39 the calculated catch was 244,242 pelts, worth $48,848.40; and in 1939-40 the catch was 171,590 pelts, worth $34,318.00, table 7. The catch figures do not represent the total numbers of opossums taken because very low prices for opossum furs in both seasons caused an unknown percentage to be thrown away by fur-takers. Another, and perhaps appreciable, part of the total take was used for food, especially by people of foreign extraction in the southern Illinois coal region, and undoubtedly pelts of many of the animals so used were not sold. The actual take may easily have been 50 per cent greater than the figures given.

Popularity.—Fur-takers showed comparatively little enthusiasm concerning the opossum. Of the fur-takers questioned in 1938-39, 234 desired more and 44 fewer opossums; of those questioned in 1939-40, 316 wanted more and 43 wanted fewer, table 7. Coming directly from trappers and hunters, these figures reflect distinct lack of appreciation. Not even the skunk ranked so low in popularity among fur-takers. Only gray fox, red fox and weasel showed lower popularity percentages, but none of these ranked among the most important Illinois fur animals. Some fur-takers objecting to a further increase of opossums were motivated by the nuisance caused by this species, as when getting into traps set for more valuable animals. Others resented opossum depredation on poultry. A few night hunters were interested in coon hunting only, and thus found the abundance of opossums objectionable. The principal reason for the opossum's position in public esteem is the low value of its fur; a higher value would register an immediate and positive change in attitude. Among non-fur-takers over the state, this species probably ranks next to foxes and weasels in unpopularity, a position undoubtedly due to its reputed destructiveness to domestic fowls.

Fig. 17.—Female opossum with nine young in pouch. The young of this species are born in an immature condition and remain in the pouch for several weeks.

Damage and Control.—The objectionable characteristics of the opossum, except for the alleged destructiveness to small game, has been sufficiently indicated in the preceding paragraphs. In situations in which opossums are known to be causing damage, the writers recommend trapping as a means of control. This is a simple remedy since opossums are easily taken in any sort of baited set. Or they may be readily taken with dogs.

Populations.—In general, fur-takers interviewed reported a steady increase in opossum numbers from 1936 to 1939, when populations seemed to level off or decrease. For the two seasons covered by the survey, the actual decrease, if any, was probably less than the 30 per cent reduction indicated by the catch. The 1939-40 catch is known to have been limited by low prices and very dry weather

Table 7.—Opossum in Illinois: Calculated catch, income, trapping and hunting data, fluctuation in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Opossums	Per Cent of Hunters Taking Opossums	Per Cent Taken By		Number of Fur-Takers Reporting on Opossum Populations			Number of Fur-Takers Desiring	
								Trappers	Hunters	Increase	No Change	Decrease	More Opossums	Fewer Opossums
Northwest Hills	1938–39	1,330	1.62	$ 266.00	$0.32	56	75	43	57	19	5	3	28	0
	1939–40	1,002	1.22	200.40	0.24	52	70	57	43	17	3	3	25	2
Western Prairie	1938–39	13,398	4.13	2,679.60	0.83	66	82	28	72	28	3	2	32	2
	1939–40	14,566	4.49	2,913.20	0.90	48	83	22	78	34	3	6	39	2
River Bluffs and Bottoms	1938–39	136,587	12.14	27,317.40	2.43	73	85	30	70	54	10	5	53	6
	1939–40	83,257	7.40	16,651.40	1.48	71	85	22	78	37	17	5	73	8
Northwestern Sand Prairie	1938–39	7,423	1.64	1,484.60	0.33	51	42	81	19	31	0	2	18	9
	1939–40	10,772	2.38	2,154.40	0.48	76	73	77	23	36	6	1	30	11
Glacial Lakes	1938–39	2,539	1.55	507.80	0.31	49	0	89	11	18	7	1	17	7
	1939–40	2,228	1.36	445.60	0.27	47	66	95	5	21	8	2	34	5
Black Prairie	1938–39	14,322	0.87	2,864.40	0.17	41	33	95	5	14	2	0	14	17
	1939–40	10,700	0.65	2,140.00	0.13	44	50	79	21	6	9	7	26	15
Central Sand Prairie	1938–39	11,850	2.08	2,370.00	0.42	33	77	14	86	11	4	3	15	0
	1939–40	8,033	1.41	1,606.60	0.28	24	92	15	85	8	5	7	22	0
Gray Prairie	1938–39	56,793	4.36	11,358.60	0.87	83	87	41	59	36	15	10	57	3
	1939–40	41,032	3.15	8,206.40	0.63	58	93	15	85	40	17	10	67	0
Illinois	1938–39	244,242	4.31	$48,848.40	$0.86	57	78	38	62	211	46	26	234	44
	1939–40	171,590	3.03	$34,318.00	$0.61	53	85	32	68	199	68	41	316	43

during the hunting season. Of 283 furtakers expressing an opinion on population change for 1938-39 in comparison with the preceding season, 211 reported an increase, 46 no change and 26 a decrease; for 1939-40 in comparison with the preceding season, 199 trappers reported an increase, 68 no change and 41 a decrease, table 7. Best explaining the increase beginning about 1936 are low prices and mild winters; the possible effect of cycles was not determined.

The opossum catch ranged from 0.65 per square mile in the Black Prairie Region in 1939-40 to 12.14 per square mile in the River Bluffs and Bottoms Region in 1938-39, table 7. The more heavily wooded parts of the state are the important opossum-producing localities. The River Bluffs and Bottoms Region leads the other fur survey regions in the acreage of wooded areas. Next to this region in opossum catch for 1938-39 were the Gray Prairie with 4.36 per square mile and the Western Prairie with 4.13 per square mile, both of which contain considerable woodland. The Central Sand Prairie with a catch of 2.08 per square mile, the Northwestern Sand Prairie with 1.64 and the Northwest Hills with 1.62 were next in rank in 1938-39. The Glacial Lakes with 1.55 and the Black Prairie with 0.87 ranked seventh and eighth, respectively. There was some variation by regions in rank for the season of 1939-40, and the catch density per square mile was generally lower, table 7.

Habitats.—The high quality of the River Bluffs and Bottoms as a habitat for opossums is at once apparent when, in addition to forest cover, the region is known to abound in bluffs and to be dotted by small irregular fields in the valleys or on the slopes. A comparatively heavy population of woodchucks provides thousands of ground dens, which, with countless tree cavities, sinkholes and small caves, supply retreats in abundance. The food supply in this region is ample and of excellent quality, with mulberries, wild grapes, brambles (*Rubus* spp.), pokeberries, persimmons and pecans generally abundant. Animal foods, including carrion, are also available in quantity. This region is less subject to fire and overgrazing than any other region except the Northwest Hills; nevertheless these two destructive practices are all too common.

Habitat conditions in the Gray Prairie, the Central Sand Prairie, the Western Prairie and the Northwestern Sand Prairie regions are similar in that the woodland is largely cut over. Forest cover in these four regions is most abundant in the Gray Prairie, but the water supply in this region is not dependable because of the large proportion of streams that are intermittent. The Northwest Hills Region generally has ample cover and water, but winters may be relatively severe. In the Glacial Lakes Region there is considerable cover in the form of wooded stream bottoms and marshy lake shores.

The Black Prairie, with the lowest acreage of woodland cover per square mile, was lowest in production of opossum furs per square mile. In this region, tree cavities are very scarce, forcing a large part of the opossum population to den underground or in debris of various sorts. Because of the level terrain and poor subsurface drainage, ground dens are easily flooded and may result in some mortality through drowning. The fact that the mother opossum carries her young in the pouch for some time after birth would seem to exclude the possibility of a very high mortality by drowning in young animals. Opossums denning in drainage tiles may suffer some drowning loss. Ground dens along ditch banks and old woodchuck holes along stream valleys and fencerows and in stripmine areas provide most of the shelter in the Black Prairie district. Natural food, which for this omnivorous species may be practically any sort of meat or fruit, is ample.

There is some evidence that opossums make use of old muskrat houses and thick growths of bulrushes and cattails along marsh areas in the northern half of the state. Wooden nest boxes erected for wood ducks are accepted as dens in both bottoms and upland areas.

Trapping and Hunting.—In Illinois, in the two survey seasons, about one-third of the annual opossum catch was taken by trappers and about two-thirds by hunters, table 7. Hunting was particularly prevalent in the Central Sand Prairie, the River Bluffs and Bottoms and the Western Prairie regions. It was least common in the Glacial Lakes, the Black Prairie and the Northwestern Sand Prairie. Over one-

half of the trappers and over two-thirds of the hunters annually took opossums. It is apparent that opossum and raccoon hunting can be closely correlated by regions, tables 7 and 8.

The sport of possum hunting is well known and is perhaps as popular and as widely practiced in southern Illinois as in the southern states. Unusually dry weather during the fall of 1939 over most of Illinois, followed by unusual cold, probably explains the reduction in catch for that season in all regions except the Western Prairie and the Northwestern Sand Prairie, where more favorable hunting conditions during the first part of the season may partly explain the slight increase in catch over that of the preceding year.

In all regions of the state, but especially in the River Bluffs and Bottoms, Gray Prairie and Western Prairie, opossum hunters can feel reasonably certain of some sport on almost any good autumn night. In the river type region and locally in the other two regions named, it is not uncommon for a hunter or group of hunters with dogs to take a dozen or more opossums in one evening. The procedure is simple. The dog or dogs are turned loose, and the hunters wait until the "tree bark" is heard, which is usually at some small tree, but may be at a sink hole, old woodchuck den or hollow log. Dogs sometimes bay opossums on the ground, and such opossums are usually killed and sometimes destroyed by the dogs before the hunter can come upon the scene. Fur-hunters, especially during the days of high prices for opossum pelts, usually attempt to bag the catch before extensive damage is done. Opossums in trees are usually taken by shooting the animals or chopping the trees down, but sometimes simply by shaking the trees until the animals drop to the ground. Those "treed" in the ground are commonly abandoned. A persimmon grove is a favored place for taking opossums at night. In the chopping of trees, night hunters cause a loss that is fairly common in southern Illinois.

Trapping opossums, at least during the era of low prices, is chiefly incidental to the trapping of minks, raccoons, skunks and foxes. Many trappers resent even incidental capture, and some trappers throw away opossums so taken. Sets, when made for opossums, are placed at the entrance of dens, on logs or at waterholes. They are usually baited, since these animals take readily almost any sort of meat foods.

Management.—Perhaps the greatest value of the opossum is the buffer effect it has on raccoon hunting. Night hunters in practically all parts of the state can depend on this species for a certain amount of sport, whereas raccoons are decidedly scarce except in the riverbottoms and forested parts of the Western Prairie, Northwest Hills and the Central Sand Prairie regions. Some sportsmen, interested chiefly or only in raccoon hunting, object to the abundance of opossums since it interferes with their sport.

In view of current market conditions, it is certain that the opossum is in little danger of greatly reduced numbers. Its prolificness, adaptability and omnivorous food habits enable it to withstand any likely hunting or trapping pressure. The present laws are satisfactory.

Raccoon

The raccoon is the most characteristic forest fur animal in Illinois. It is common to fairly abundant in all extensively wooded regions of the state and scarce elsewhere. The catch per square mile in the River Bluffs and Bottoms, the largest wooded region, was 1.93 raccoons in 1938-39 and 1.55 in 1939-40, while the catch per square mile in the Black Prairie Region, with the smallest acreage of forest cover per unit of area, was only 0.09 and 0.07 raccoon for the two seasons of the survey, table 8.

For the season of 1938-39, the total calculated catch was 42,412 raccoons, worth $84,824; and in 1939-40, 34,577 raccoons, worth $69,154, table 8. During these two years, the value of raccoon fur was low, the average price per pelt being only about $2, table 5. An average value of $4 or $5 per pelt is a more nearly normal price. The annual income from this species for the two seasons of the survey was only about 6½ per cent of the total annual worth of the fur resource in Illinois, table 20.

Popularity.—Without doubt the raccoon has wider appeal to the American public than any other furbearer, with the possible exception of the beaver. It can properly be considered the best "all

around" fur animal, since it produces income, affords sport and food, and ranks high in aesthetic appeal. Of the Illinois fur-takers contacted concerning their opinion of the raccoon, 356 in 1938-39 and 387 in 1939-40, only 1 in each year desired fewer of these animals. Depredations by raccoons on corn and poultry are overlooked far more readily by farmers, fur-takers and non-fur-takers alike than similar activities on the part of opossums, skunks, weasels and foxes.

The sport value of raccoons, especially during an era of low prices, is probably the greatest worth of these animals in Illinois. The income value, considerably less than $100,000 annually at the time of the survey, is probably exceeded by the yearly turnover involved in the care, training and sale of coon dogs. At price levels current when the survey was made, it is difficult for a coon hunter to take enough raccoon furs to cover the annual upkeep of his dogs. This is certainly true in cases where vaccinations, registration fees and other kennel expenses are figured in the cost.

Damage and Control.—Raccoon damage is very minor except in cornfields bordering woodlands holding sizable raccoon populations. A foray on poultry is occasionally reported, and a very few cases of injury to cultivated fruits and brambles are on record. Injury of this sort is considered too insignificant to justify control, but in instances in which it is required the writers recommend trapping, in season if possible; if not in season, the liberation of captured animals at points removed from the scene of the damage. Before trapping is attempted, Illinois State Department of Conservation investigators should be consulted and, if necessary, their aid in capture and liberation of the animals enlisted.

Populations.—On the basis of available records, and the opinion of hundreds of fur-takers, no Illinois fur animal has shown a sharper decline in numbers during recent years than the raccoon. Of 253 fur-takers expressing an opinion for the season of 1938-39 in comparison with the preceding season, 179 indicated a decrease, 41 no change and 33 an increase; for the season of 1939-40 in comparison with the preceding season, 183 trappers reported a decrease, 58 no change and 58 an increase, table 8. In addition, many experienced fur-takers were positive in their opinions that the decrease had been steady and rapid during the preceding 5 or 10 years.

Of fur-takers reporting an increase, about 25 per cent were from the upland communities of Calhoun County, only a few miles removed from extensive bottomland clearing made in conjunction with channel improvement along the Mississippi and Illinois rivers. Such clearing forced raccoons into the nearby timbered bluffs, thus affording there a year or two of increased populations and good hunting. The catch in this county in 1938-39 was very high, with 2.66 raccoons per square mile. The annual catch, according to unverified but general belief among experienced hunters in this region, represented about one-half of the total population. A density of five raccoons per square mile was thus indicated for the county as a whole, the population being, of course, of even greater density on actually inhabited areas. This was the heaviest raccoon population encountered during the study.

Following completion of the survey we had numerous and apparently reliable reports of increases in raccoon numbers, noticeable particularly in 1941 and 1942. These increases are believed to have resulted from three factors that had tended to reduce the raccoon catch: low prices on raccoon furs, good agricultural crops and prices, and increased employment in industry. The additional breeding stock built up by these conditions may indeed have resulted in somewhat larger populations, despite accelerated depletion of the raccoon habitat. Such gains may be only temporary and may be easily lost during periods of good fur prices and greater than normal take.

Habitats.—It is natural that a raccoon population as high as that found in Calhoun County should occur in an excellent habitat. An abundance of heavy timber and bluffs afforded plenty of cover and dens; the water supply, consisting of large rivers, lakes, swamps, marshes and spring runs, was excellent; and extensive and widely scattered areas of brush, cultivated fields and thousands of food-producing forest trees, such as pecan and persimmon, offered ample food. Despite heavy hunting, a breeding reserve of raccoons was left because of the difficulty in removing "treed" animals from the hundreds of

Table 8.—Raccoon in Illinois: Calculated catch, income, trapping and hunting data, fluctuation in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Raccoons	Per Cent of Hunters Taking Raccoons	Per Cent Taken By		Number of Fur-Takers Reporting on Raccoon Populations			Number of Fur-Takers Desiring	
								Trappers	Hunters	Increase	No Change	Decrease	More Raccoons	Fewer Raccoons
	1938–39	665	0.81	$ 1,330.00	$1.62	25	83	34	66	1	3	21	35	0
Northwest Hills	1939–40	690	0.84	1.380.00	1.68	39	60	42	58	3	7	19	30	0
	1938–39	2,563	0.79	5,126.00	1.58	43	54	61	39	5	4	19	34	0
Western Prairie	1939–40	3,504	1.08	7,008.00	2.16	40	51	57	43	16	1	19	44	0
	1938–39	21,714	1.93	43,428.00	3.86	36	57	41	59	10	8	45	79	0
River Bluffs and Bottoms	1939–40	17,439	1.55	34,878.00	3.10	40	64	30	70	19	17	38	81	0
	1938–39	2,489	0.55	4,978.00	1.10	22	50	39	61	8	2	21	38	0
Northwestern Sand Prairie	1939–40	2,444	0.54	4,888.00	1.08	28	63	41	59	2	10	19	44	0
	1938–39	344	0.21	688.00	0.42	14	100	89	11	0	0	20	46	1
Glacial Lakes	1939–40	475	0.29	950.00	0.58	21	0	100	0	6	5	14	48	1
	1938–39	1,482	0.09	2,964.00	0.18	9	16	70	30	0	1	7	29	0
Black Prairie	1939–40	1,152	0.07	2,304.00	0.14	4	50	50	50	1	1	7	40	0
	1938–39	4,558	0.80	9,116.00	1.60	10	76	7	93	4	7	9	27	0
Central Sand Prairie	1939–40	3,532	0.62	7,064.00	1.24	13	83	17	83	10	2	19	29	0
	1938–39	8,597	0.66	17,194.00	1.32	32	67	40	60	5	16	37	68	0
Gray Prairie	1939–40	5,341	0.41	10,682.00	0.82	21	62	25	75	1	15	48	71	0
	1938–39	42,412	0.75	$84,824.00	$1.50	23	61	40	60	33	41	179	356	1
Illinois	1939–40	34,577	0.61	$69,154.00	$1.22	26	61	38	62	58	58	183	387	1

caves and sinkholes in the bluffs. As stated, recent clearing in Calhoun County disturbed the raccoon population there and seems to have resulted in a total larger catch, as well as a reduction in habitable range (Yeager & Rennels 1943). The raccoon, figs. 6, 18, and 22. Among possible den sites, tree cavities rank highest with this species. Rock or ground cavities may be used, but where timber is present they are generally passed up except as escape cover. The opossum readily dens in

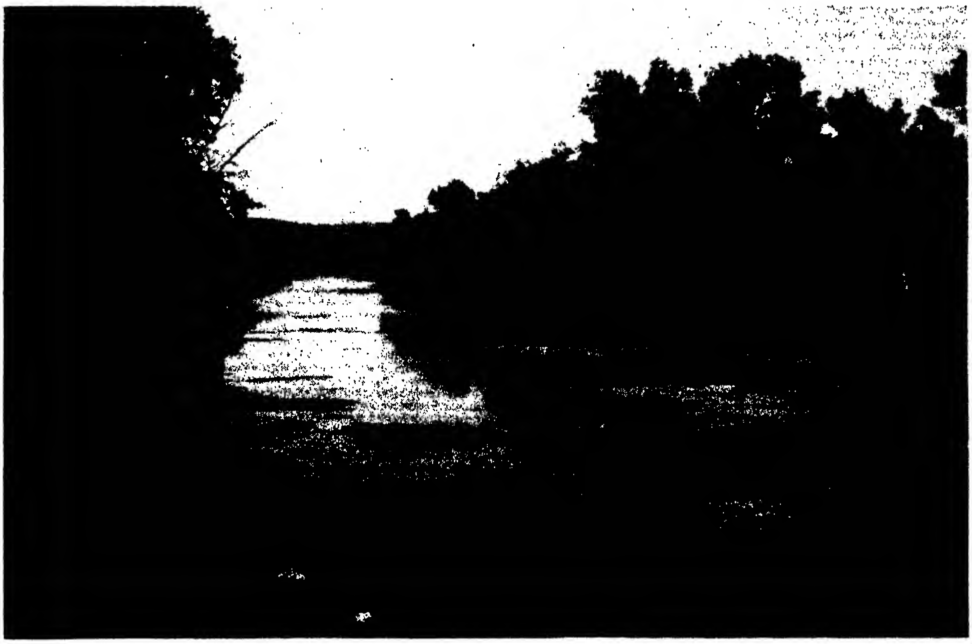

Fig. 18.—Big Slough, Pere Marquette Wildlife Area, Calhoun County. The riverbottom type shown here is probably optimum for raccoons.

river bluffs and bottomland habitat, generally, is now gradually being depleted by timber cutting, overgrazing, fire and erosion.

In table 9 an attempt is made to evaluate the influence of forest cover, grazing and water on the several types of raccoon habitats in the state, as reflected in the catch per square mile.

It is apparent that there is some correlation between raccoon numbers and the proportion of woodland in given regions, but the influence of woodland may be affected by various other factors. Water is believed to be the most important of these. Grazing, fire, maturity of woodland and other conditions have some effect, undetermined in this study.

The raccoon does not possess to the same degree the opossum's adaptability to a wide variety of habitats. Forest cover and a plentiful water supply appear to be more or less inflexible requirements of the the ground, even in the vicinity of tree cavities (Yeager 1936).

The Northwest Hills Region affords excellent raccoon cover, both forest and bluff, but much of the wooded area is too far from water to be of high attractiveness. Water, except along the Mississippi River, is in the form of small, steep-banked streams. There are few heavily wooded swamps or large riverbottoms, which appear to furnish the best type of raccoon habitat. Pelts from this region are dark and well furred, a high percentage of them grading as "collar" raccoon.

The Western Prairie, Central Sand Prairie, Northwestern Sand Prairie and the Glacial Lakes regions are alike in that water is generally available. This consists of streams, marshes and sizable lakes, and along the Illinois River a very limited amount of wooded swamp. The degree of grazing varies widely, being especially heavy in the Northwestern Sand Prairie,

the Glacial Lakes and the Western Prairie regions. Many of the shallow, marsh-bordered lakes in the Glacial Lakes Region are some distance from forest cover, a fact which may partially explain the low raccoon population there. In all of these regions, the woodland has largely been cut over, resulting in the loss of a large percentage of the den trees.

In the Gray Prairie Region, comparatively large timbered areas occur, but den trees are scarce because of long-continued lumbering operations, and also because many den trees have been cut by hunters and others. There are few bluffs in this region suitable as raccoon retreats. Water, supplied chiefly by small, intermittent streams, is scarce and undependable. Pasturing of woodlands, because of their comparatively large area, is not so heavy as in the Northwest Hills, the Glacial Lakes or some other regions.

The large Black Prairie Region offers the poorest raccoon habitat in the state. It is acutely short of forest cover, and practically all of the woodland is pastured. It contains few bluffs suitable for ground dens. Water is scarce and undependable over this prairie because of the intermittent nature of many of the streams and ditches. Food, as in all other regions, is probably ample, although it falls far short of the variety and, except in corn, of the quantity found in riverbottoms.

The severe shortage of dens throughout the prairie districts is indicated by the use made of muskrat houses. On three occasions, the authors found hibernating raccoons using muskrat houses and evidence of such use on many other occasions. Trappers along the Illinois River often reported use by raccoons of muskrat houses, and even of thick tangles of bulrushes, both as hibernating and overnight retreats.

Table 9.—Effect of forest cover, grazing and water on Illinois raccoon habitats, as reflected in the calculated raccoon catch per square mile.

Fur Survey Region	Per Cent of Region in Woodland*		Water Resources (In Relation to Suitability to Raccoons)	Raccoon Catch per Square Mile, 1938–39, 1939–40
	Total	Ungrazed		
River Bluffs and Bottoms	24	13.0	Excellent: Large rivers, creeks, lakes, swamps, marshes	1.74
Western Prairie	11	1.0	Good: Year-around streams, ditches, marshes	0.94
Northwest Hills	17	1.0	Good: Year-around streams, spring runs	0.83
Central Sand Prairie	6	4.0	Good: Streams, ditches, marshes	0.71
Northwestern Sand Prairie	3	0.3	Very good: Year-around streams, marshes	0.55
Gray Prairie	7	4.0	Poor: Small, intermittent streams	0.54
Glacial Lakes	7	0.6	Good: Lakes and marshes, some streams	0.25
Black Prairie	2	0.1	Poor: Intermittent streams and ditches	0.08

*U. S. Department of Commerce, Bureau of the Census, Agriculture—Illinois, 1935, pp. 9-15. Percentage figures calculated from data given on grazed and ungrazed woodland, by counties; based only on sample counties.

Trapping and Hunting.—In Illinois in the two seasons of the survey, about two-fifths of the annual catch of raccoons was made by trappers and about three-fifths by hunters, table 8. Hunting was especially prevalent in the Central Sand Prairie, the River Bluffs and Bottoms, the Northwest Hills, the Gray Prairie and the Northwestern Sand Prairie regions. Trapping was the chief means of capture in the other regions; coon hunting apparently was practiced very little in the Glacial Lakes Region.

Fig. 19.—Raccoons accept artificial dens if the dimensions and location are satisfactory. The best locations are probably near water. The raccoon shown here is at the bottom of a den box placed in the Urbana Township Wildlife Area, Champaign County.

Coon hunting is a night sport too well publicized to require lengthy discussion here. The writers desire only to mention that a sizable business is represented in the coon dog breeding and training industry, and that coon hunters in general pursue the sport more for the pleasure it affords than hope of pecuniary reward. This was true especially during the era of low prices in which the survey was made. Hunters, in order to perpetuate their sport, to say nothing of the resource, should refrain from cutting den trees or timber of any sort; there seems to be a growing sentiment to this effect. Very cold or very dry weather tends to make poor coon hunting; the severe drought followed by cold weather and deep snow in 1939-40 may account in part for the reduced raccoon catch for that season.

The scarcity of raccoons has caused numerous coon-hunting clubs, especially in the northern part of Illinois, to demand restocking by the state. In response, the Illinois State Department of Conservation in 1939, at its game farm near Mount Vernon, began artificial propagation of this species.

Raccoons are trapped in both baited and nonbaited or "blind" sets, usually in water. Fish, rabbit and similar meat attractors are commonly used. Traps set on logs, particularly in the vicinity of water, are usually productive. Den sets are not common, due to their inaccessibility. A strong trap, such as the No. 2, is needed because the raccoon possesses great strength and makes a courageous fight for freedom. Confirmed coon hunters are apt to look upon trapping as unsportsmanlike, and feel that trappers encroach upon their sport. In Illinois, especially in the southern half of the state, there is considerable dissention between coon hunters and trappers.

Management.—The most obvious need in restoring raccoon population is an improved habitat. This, when it involves the production of tree cavities, becomes a long-time program. Very desirable steps in restoring forest cover are being taken by the Illinois State Division of Forestry, the U. S. Forest Service and the U. S. Soil Conservation Service. To be most valuable to raccoons, plantings should be of hardwoods and located in the vicinity of water.

Cutting of den trees should be stopped. In localities where bluffs do not occur, and the topography is too flat and the soil too poorly drained to permit satisfactory ground denning, there is no practice more destructive to present and future raccoon populations than den-tree cutting. It should be remembered that 40 to 60 years are required to grow a den tree, even on good sites and with rapidly growing species such as soft maple. Conditions unsuitable to ground denning exist throughout the prairie regions, including most of the stream bottoms.

The utility of artificial dens has not been adequately studied, but the writers feel that they may have an important place in management, fig. 19. For example, if a practical and satisfactory den box can be developed, young timber stands that are in the vicinity of water but that lack natural cavities could be turned into productive habitats. Acceptable boxes should have minimum inside dimensions of 12 by 15 inches. The entrance hole should be 6 inches in diameter and the cavity at least 3 feet deep. Such boxes made in quantity from No. 1 cypress

lumber would cost probably $2 each; if constructed from state-owned timber they could be made at a lower cost. Good cypress den boxes, with some maintenance, would last at least 10 years, giving an annual cost of 20 cents each, plus upkeep expense. Artificial dens should be erected well off roads, substantially fastened in or above the first crotch of the largest trees available, and probably they should be placed near water. A box design bringing the entrance hole close to the tree trunk permits easy access.

Boxes similar to the raccoon den just described are known to be readily used by opossums, squirrels and certain cavity-nesting birds. Such boxes on the Urbana Township Wildlife Area are being used by raccoons; the closest timber is about 2 miles away. Honeybees and other insects also make appreciable use of these boxes. Work necessitated by pre-emption of these forms would be a major item of the maintenance cost. If this and similar work could be done by sportsmen's clubs, upkeep cost would be low.

Raccoon laws, in view of the conflicting interests of hunters and trappers, are difficult to formulate. The writers believe that, as a principle, the enactment of laws favoring either of the groups at the expense of the other would be unwise, and that both groups have rights that should be considered in laws regulating capture of this popular species. Trappers, in general, take the animals as a means of livelihood; hunters, in general, take them as a means of sport. Since it is obviously impossible to satisfy completely both groups, we recommend a uniform trapping and fur-hunting season on all species, opening Dec. 1 and closing Jan. 31. It is realized that the raccoon season opening Dec. 1 would operate against both hunters and trappers, because raccoons hibernate during cold weather which often comes, especially in northern Illinois, during December. However, the present low raccoon population justifies a reduced catch, and in time this season would benefit both groups.

The summer training of coon dogs is another delicate, but rather important, point in the making of raccoon regulations. The writers are of the opinion that any disturbance of raccoons, such as that caused by summer training, is undesirable if only the welfare of the species is considered. However, coon dog breeders and trainers have a considerable investment, and the business provides a livelihood, wholly or in part, for several hundred people in the state. Just laws should take these facts into consideration. The 1941-42 law permitted the hunting of raccoons for the purpose of dog training from Aug. 15 through March 31. We believe that, for the best interests of all concerned, these dates should be changed to Sept. 15 and Jan. 31, since the first date would permit young raccoons to attain greater size and maturity, and the second would largely prevent interference with breeding, as is possible under the March 31 closing law. Even the law as proposed has one bad feature, that of tempting hunters to take illegally more or less prime furs from the first of November until the season opens. An alternative is to close this period to dog training.

Raccoons are commonly taken in traps set for almost any Illinois furbearer, a condition that precludes practical trapping laws favoring this species, even if such laws were fair and desirable. It would, of course, be possible to close the entire state or given parts thereof to all coon hunting and trapping for a year or two, with provisions for releasing raccoons unavoidably taken in traps. Such a law would involve complications in law enforcement, in the release of severely injured animals, and in the utilization or waste of raccoons drowned after being taken in traps. At best this law is in the category of "last resort." It would be far more desirable to institute a vigorous campaign of habitat restoration involving protection of den trees, erection of artificial dens, development of water resources, protection of areas against fire and overgrazing and, where needed, liberation of a moderate number of artificially reared raccoons. These provisions, plus the shortened trapping and dog training seasons proposed, should offer a slow but effective means of restoring naturally both the population and the habitat.

The effectiveness of complete protection of raccoons on given areas as a restoration measure should not go unmentioned. The writers know of three areas in which little management other than complete protection has resulted in the building up of very high raccoon populations. These

areas are the Chautauqua National Wildlife Refuge in Mason County, the Horseshoe Lake Game Refuge in Alexander County and the U. S. Army Proving Grounds in Carroll County. All are riverbottom types in proximity to water. Protection in these areas has extended over a period of 10 years or more, and on all there is now need for the removal of a part of the raccoon population in order to prevent overcrowding.

Skunk

The taxonomic status of skunks in Illinois has never been satisfactorily determined (Anthony 1928, Hall 1936, Gregory 1936, and Necker & Hatfield 1941). Whatever their systematic position, for purposes of this survey striped skunks have been grouped under *Mephitis mephitis*. The spotted skunk, *Spilogale*, apparently does not occur in the state.

Striped skunks are rather generally distributed throughout Illinois. For the season of 1938-39, the total calculated catch was 49,640, worth $37,230; and in 1939-40 the calculated catch was 36,681, worth $36,681, table 10. During the two seasons covered by the study, skunk prices were low, the average being 75 cents for the first year and $1 for the second, table 5. The normal value is nearly twice as much. In catch value, skunks ranked fifth among Illinois fur animals, with slightly more than 3 per cent of the total, table 20. The true value of the species, however, is determined only by evaluating its insect-eating proclivities and adding this value to fur income worth.

Popularity.—In Illinois only the red fox appears to have a position more variable in public esteem than the skunk. One farmer may consider a family of barn-dwelling skunks good insurance against rats and mice; and his neighbor may condemn them because of actual or assumed injury to poultry. Many orchardists in southern and southwestern Illinois protect skunks because of their services as mousers and insect eaters, while sportsmen in the same regions demand control of these animals in the interest of game birds. Of 604 answers received as to fur-takers' opinions of skunks, 35 favored fewer of the animals, table 10. Only the opossum ranked lower in favor as a fur species, and only the weasel had a lower rating in general public opinion.

Damage and Control.—Skunks are objectionable more from the standpoint of nuisance than actual damage to property. Their nuisance quotient probably reaches its zenith when they den under dwellings or farm outbuildings, which they not infrequently do. Farm dogs inevitably run afoul of farmstead skunks, and the results can be detected from afar. Most such skunks, with some justification, are not reserved until the winter fur harvest.

Damage by skunks to beehives, lawns and pastures, all in quest of insect food, is commonly reported. Although damage to beehives represents an actual loss, the digging of grubs and other insects almost certainly prevents greater injury to grass and field crops. Occasional to habitual destruction of poultry is perhaps the worst offense of which skunks are guilty. Habitual depredation is usually confined to individual animals, the elimination of which affords ample control. Because skunks are poor climbers, their injury to nests and eggs is confined to ground-frequenting birds.

Skunk control has recently been well discussed by Green & Mills (1941). Where practicable, trapping with No. 1 or No. 1½ traps during the fur season is the most desirable control, since the animals can then be made to yield a cash income. Skunks are easily trapped in trails, coop entrances, passageways through fences or at baited sets in the vicinity of their dens. They are also easily taken in box traps, in which they may be drowned before being removed. In tight box traps or similar containers they may be killed quickly, and without unpleasantness to the killer, with carbon bisulphide, ether or chloroform. Shooting with a small rifle is probably the most practical way to kill trapped skunks, but this method does not insure against "scenting." We consider wide-scale control of skunks in the interest of upland game or for similar purposes to be inadvisable at any time.

Populations.—In the two seasons of the survey, the annual skunk catch showed more change by regions than that of any other important fur animal. The state as a whole showed a decrease in catch for the second year of about 26 per cent, table 10, despite a 33⅓ per cent increase in

Table 10.—Skunk in Illinois: Calculated catch, income, trapping and hunting data, fluctuations in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Skunks	Per Cent of Hunters Taking Skunks	Per Cent Taken By: Trappers	Per Cent Taken By: Hunters	Number of Fur-Takers Reporting on Skunk Populations: Increase	No Change	Decrease	Number of Fur-Takers Desiring: More Skunks	Fewer Skunks
Northwest Hills	1938–39	846	1.03	$ 634.50	$0.77	56	16	88	12	7	9	4	25	0
	1939–40	1,174	1.43	1,174.00	1.43	70	20	93	7	13	7	4	22	2
Western Prairie	1938–39	1,882	0.58	1,411.50	0.44	43	55	42	58	3	5	20	33	1
	1939–40	2,044	0.63	2,044.00	0.63	40	48	57	43	6	2	28	39	1
River Bluffs and Bottoms	1938–39	13,839	1.23	10,379.25	0.92	49	29	59	41	19	15	5	64	3
	1939–40	12,939	1.15	12,939.00	1.15	50	39	50	50	40	11	11	71	4
Northwestern Sand Prairie	1938–39	2,942	0.65	2,206.50	0.49	43	8	96	4	12	1	18	27	1
	1939–40	5,160	1.14	5,160.00	1.14	62	18	97	3	19	11	3	32	1
Glacial Lakes	1938–39	1,523	0.93	1,142.25	0.70	34	0	100	0	13	10	3	22	3
	1939–40	885	0.54	885.00	0.54	28	0	100	0	14	2	15	36	1
Black Prairie	1938–39	19,425	1.18	14,568.75	0.88	45	16	99	1	20	0	1	23	10
	1939–40	6,420	0.39	6,420.00	0.39	35	0	100	0	4	4	11	30	6
Central Sand Prairie	1938–39	2,279	0.40	1,709.25	0.30	28	7	95	5	2	6	4	12	0
	1939–40	2,849	0.50	2,849.00	0.50	26	33	61	39	2	3	13	20	0
Gray Prairie	1938–39	6,904	0.53	5,178.00	0.40	49	31	72	28	12	17	17	50	2
	1939–40	5,210	0.40	5,210.00	0.40	40	31	70	30	10	15	27	63	0
Illinois	1938–39	49,640	0.88	$37,230.00	$0.66	43	28	78	22	88	63	72	256	20
	1939–40	36,681	0.65	$36,681.00	$0.65	43	34	75	25	108	55	112	313	15

market price of the fur, table 5. This condition strongly suggests a substantial decrease in the population. Four regions showed a decline in catch. The Black Prairie, with a catch decreasing from 19,425 to 6,420, absorbed most of the loss. This is a decline of nearly 70 per cent. The Glacial Lakes Region showed a decline of about 50 per cent, and the Gray Prairie a decline of less than 25 per cent. An increase over the 1938-39 catch occurred in four regions; the increase was most pronounced in the Northwestern Sand Prairie, where it amounted to over 75 per cent. Thus, losses occurred in the northeastern, central, and southern parts of Illinois, and gains in the central west and northwest. We are unable to explain these population trends and changes.

Quantitatively, the catch varied from a 2-year average of 0.45 skunk per square mile in the Central Sand Prairie and 0.47 per square mile in the Gray Prairie to 1.19 per square mile in the River Bluffs and Bottoms and 1.23 per square mile in the Northwest Hills. The average catch for the state was 0.88 per square mile in 1938-39 and 0.65 per square mile in 1939-40, table 10.

Fur-takers' opinion of population fluctuation was divided. In 1938-39, 88 of the persons questioned believed there had been an increase over the previous year, 63 no change and 72 a decrease; in 1939-40, 108 reported an increase over the previous year, 55 no change and 112 a decrease. Many experienced trappers reported that the skunk population in the Black Prairie belt a year or two prior to 1938 had dropped to a very low level. If this report is true, a quick build-up necessarily had occurred to make possible a catch of 1.18 per square mile for the season of 1938-39. The fact that the catch dropped to 0.39 per square mile the following season, despite higher prices, indicates that sudden and violent fluctuations in density may occur in this species.

Disease seems to be the only available explanation of such great changes in skunk numbers, but what disease and how it works is unknown. The fluctuation is strongly suggestive of cyclic behavior. In several sample counties, trappers reported the finding of dead or paralyzed skunks in the field. Of three skunks examined by the writers, one had died of injuries inflicted by an automobile, and one from the combined effects of exposure and infection due to the loss of a front foot, probably in a trap; the third, taken in a barn lot, was rabid. A partial explanation of the fluctuation may lie in extensive woodchuck gassing campaigns and the depredations of hundreds of free-ranging dogs, especially in the southern half of Illinois. Neither factor, nor the combination of the two, can account for the suddenness and the degree of downward fluctuation apparent on the Black Prairie where gassing was most common. Even if they could account for the decrease, their absence could scarcely be responsible for the almost equally well-marked build-up in the population noted in 1939-40 in the Northwestern Sand Prairie. Disease, or the operation of a cycle, remains as the most logical explanation.

Habitats.—Scarcity of suitable cover, range and denning sites constitutes the chief shortcomings of Illinois skunk habitats. A shortage of water may be an additional problem in the Gray Prairie and Black Prairie regions. Food in the form of insects, mice, amphibians and carrion is undoubtedly ample in all regions; and the food problem is further reduced because of hibernation during severe weather when most of the above foods are difficult to obtain.

The characteristics of a good skunk habitation are not precisely known, but since the largest Illinois catches are made in rolling or bluff country, in which mixed farming is practiced, figs. 5 and 25, and where there is a considerable area of timber and pasture land with good water resources, it can be assumed that these localities offer the best habitats in the state. The Gray Prairie Region, which showed one of the lowest yields, has some of the same characteristics; but water is scarce there and undependable, bluffs are lacking, and more of the region is subject to burning. The function of bluffs may be important, since skunks living or hiding in them are protected against den destruction (now illegal); such protection, perhaps, results in a larger breeding reserve. The use of woodchuck holes, especially for hibernating, is very common among skunks. Occasionally hollow trees or stumps are so utilized, fig. 20. The Gray Prairie Region, as well as the Northwest

Hills, contains many logged-over and uncultivated areas devoted to grazing or orcharding which afford fair skunk range.

Topographic and soil conditions in the Black Prairie Region are particularly unfavorable for ground dens. Of this region, probably less than 5 per cent, chiefly in the form of stream banks, satisfactorily meets the requirements of drainage and concealment for ground-denning mammals such as woodchucks and skunks. Heavy rains during the spring of 1939 and 1943 may have resulted in some skunk mortality, especially of young, through drowning. Throughout the Black Prairie, skunks den along ditch banks, tile drains, or under woodpiles or farm buildings. The various sand and other prairie regions of the state are rolling enough to afford good ground-denning sites.

Trapping and Hunting.—Its slow movements and characteristic defense disqualify the skunk as a sporting species. Most of the skunks taken by hunters are captured incidentally to raccoon, opossum and mink hunting. About 20 per cent of the total catch is taken by hunters, and only about one out of five hunters is fortunate—or unfortunate—enough to capture them even incidentally. A very few hunters who specialize in skunks were encountered during the survey, chiefly in the Western Prairie and the River Bluffs and Bottoms regions. Practically no skunk hunting is done in the Glacial Lakes or Black Prairie regions.

Trappers, always strongly influenced by prices, were comparatively indifferent toward skunks. A large part of the catch was taken in connection with raccoon, fox and mink trapping. However, where skunks were numerous, and especially when a series of dens was located, trappers made deliberate efforts to take them. Serious skunk trapping is most common in the Northwest Hills, where the first weeks of the season are devoted to muskrats and minks; after the formation of ice, traps are moved to the uplands for skunks and foxes. Even in this region, trappers whose regular business calls for meeting the public avoid skunks and quickly dispose of those taken in sets made for other animals.

Management.—In view of the general though thin distribution of skunks in Illinois, the problems imposed by the cyclic-like behavior of the species and the ease with which the animals are taken in any sort of upland set, we have no specific recommendations for management. It appears most practical to continue to list skunks with other fur animals and to subject them to the same open season. The public, farmers and sportsmen especially, should realize that the skunk is one of the most valuable rodent and insect controls. We are opposed to large-scale control of this species in the interest of game or poultry. We endorse land use leading toward the reforestation and protection of stream banks and other areas not suited to cultivation. Such a policy should ultimately result in more wildlife habitats, from which skunks would benefit.

Fig. 20.—Skunk den in base of overmature white elm, Pere Marquette Wildlife Area, Calhoun County.

Mink

Two subspecies of minks occur in Illinois, the common mink and Mississippi valley mink (Necker & Hatfield 1941). The ranges of the two overlap, but the former has the more southerly distribution. The common mink is slightly smaller and darker than the other subspecies.

Minks, like skunks, are generally distributed over Illinois; the density of population appears to parallel muskrat numbers and the amount of permanent water. For the season of 1938-39 the total calculated catch was 53,723, worth $376,061; and in 1939-40, 45,254, worth $271,524, table 11. The take of the second year shows a decline of about 16 per cent from that of the first. The decline in value was somewhat more, since the average price

per pelt dropped from $7 for 1938-39 to $6 for 1939-40, table 5. Even after the drop in price, the mink remains, per pelt, the most valuable fur animal now occurring in the state. These prices may be considered low, in view of a value of nearly twice as much during a part of the previous decade. Minks, with about 4 per cent of the total number of fur animals pelted, ranked third in the catch for the two seasons of the survey, table 20.

Popularity.—Among trappers the mink is even more popular than the muskrat, although the difference is slight. These two species constituted over 72 per cent of the annual catch and over 84 per cent of the annual value of all Illinois raw furs for the seasons of the survey, table 20. As would be expected, the popularity of minks among non-fur-takers is not so high, since by many farmers and sportsmen the species is considered in the light of its occasional depredation on poultry and game birds. Out of a total of 718 answers from fur-takers in regard to opinion of minks, only 8 favored fewer of these animals, and it is probably significant that 7 of the 8 answers were from the Black Prairie and Glacial Lakes regions, in parts of which poultry raising and hunting pressure are maximum for the state. It is safe to say that minks rank higher than opossums, weasels and skunks in general public esteem.

Damage and Control.—The chief damage caused by minks has been indicated. Individual minks may indeed be destructive; we have a number of recent reports to this effect. Individual minks have been known to kill a dozen or more chickens in one night. Perhaps the greatest economic loss caused by the species is to muskrats. Dearborn (1932) found that in southern Michigan about one-fourth of the winter food of minks consisted of muskrats, which are also part of the summer diet, but the proportion is probably lower because of the greater availability in summer of other warm-blooded prey. A number of trappers along the Illinois River, and one manager of a 2,600-acre duck club and muskrat ranch, reported that they killed minks at every opportunity throughout the year. This club manager reported finding 13 freshly killed muskrats, 2 mallards and a coot in one mink den. The muskrats were sold for $1.90 each and the mink pelt for $12.50 (Yeager 1943*a*).

Trapping is recommended as the best means of mink control. Minks, quite properly considered intelligent mammals, are rather easily taken in both trail and baited sets. Because of the high value of the furs, we strongly recommend that, where possible, control be postponed until the winter months. In the event that control at other seasons is necessary, release of trapped animals at points where damage is not likely to occur may well result in a future income of several dollars per mink.

Populations.—The annual mink catch for the period covered by the survey indicates considerable variation in population density by regions. The take of 0.95 mink per square mile in 1938-39 and 0.80 per square mile in 1939-40 represents a reduction of about 16 per cent; for muskrats the reduction in take during the same period was about 25 per cent; for opossums, 30 per cent; raccoons, 19 per cent; and skunks, 26 per cent. The reduction of 14 per cent in the value of mink pelts in 1939-40, table 5, does not explain the reduction in catch, since any animal worth an average of $6 each, and which is as small and as easily handled as the mink, is captured by fur-takers at every opportunity. Practically all experienced trappers interviewed were of the opinion that a steady decline in mink populations had been in progress for several years. Of the trappers expressing an opinion on the catch for 1938-39 as compared with that for the previous year, 55 reported an increase, 64 no change and 112 a decrease; for the season of 1939-40, 55 reported an increase, 64 no change and 156 a decline, table 11.

The Glacial Lakes Region, with 2.69 and 2.76 pelts per square mile for the two seasons of the survey, showed by far the heaviest mink catches. The River Bluffs and Bottoms Region was second, with catches of 1.70 and 1.20 minks per square mile. The Western Prairie (0.92 and 1.22), Northwest Hills (0.87 and 0.91), the Gray Prairie (0.99 and 0.78), Northwestern Sand Prairie (0.71 and 0.97), Black Prairie (0.52 and 0.36) and the Central Sand Prairie (0.32 and 0.36) followed in this order, table 11. In the second season as compared with the first,

Table 11.—Mink in Illinois: Calculated catch, income, trapping and hunting data, fluctuation in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Minks	Per Cent of Hunters Taking Minks	Per Cent Taken By: Trappers	Per Cent Taken By: Hunters	Number of Fur-Takers Reporting on Mink Populations: Increase	No Change	Decrease	Number of Fur-Takers Desiring: More Minks	Fewer Minks
	1938–39	714	0.87	$ 4,998.00	$6.09	50	0	100	0	1	5	13	28	0
Northwest Hills	1939–40	747	0.91	4,482.00	$5.46	45	0	100	0	7	3	11	28	0
	1938–39	2,984	0.92	20,888.00	6.44	53	32	68	32	5	7	16	36	0
Western Prairie	1939–40	3,958	1.22	23,748.00	7.32	57	31	84	16	6	13	12	42	0
	1938–39	19,127	1.70	133,889.00	11.90	43	19	85	15	4	12	15	60	0
River Bluffs and Bottoms	1939–40	13,501	1.20	81,006.00	7.20	67	14	81	19	7	9	27	70	0
	1938–39	3,213	0.71	22,491.00	4.97	51	0	100	0	12	3	12	34	0
Northwestern Sand Prairie	1939–40	4,390	0.97	26,340.00	5.82	68	0	100	0	9	13	12	40	0
	1938–39	4,406	2.69	30,842.00	18.83	79	0	100	0	7	17	18	47	1
Glacial Lakes	1939–40	4,521	2.76	27,126.00	16.56	77	0	100	0	18	13	15	58	3
	1938–39	8,560	0.52	59,920.00	3.64	27	16	98	2	3	3	11	33	2
Black Prairie	1939–40	5,926	0.36	35,556.00	2.16	40	0	100	0	2	4	22	42	1
	1938–39	1,823	0.32	12,761.00	2.24	28	31	78	22	2	4	16	35	0
Central Sand Prairie	1939–40	2,051	0.36	12,306.00	2.16	21	25	42	58	1	1	15	29	0
	1938–39	12,896	0.99	90,272.00	6.93	64	44	71	29	21	13	11	61	1
Gray Prairie	1939–40	10,160	0.78	60,960.00	4.68	63	40	65	35	5	8	42	67	0
	1938–39	53,723	0.95	$376,061.00	$6.64	52	24	87	13	55	64	112	334	4
Illinois	1939–40	45,254	0.80	$271,524.00	$4.79	57	23	87	13	55	64	156	376	4

the catch showed reduced populations in the River Bluffs and Bottoms, the Black Prairie and Gray Prairie regions. All other regions showed an increased catch. Drought during the fall of 1939 may be advanced as a reason for the decline in the Black Prairie and Gray Prairie regions. The cause or causes for the appreciable decline in the River Bluffs and Bottoms Region are not known, but they may be suggested by certain social and economic factors peculiar to the region. It is certain that this area bears a heavy trapping and fur hunting pressure. Reasons for increased catches in the northern and northwestern parts of the state are likewise unknown.

Habitats.—Illinois mink habitats are so variable that they range from glacial marshes in the northeastern part of the state to cypress swamps in the southern tip, figs. 21 and 22. It is doubtful which type of habitat offers the better range; the yield for Lake County averaged 2.73 minks per square mile for the two seasons of the survey, and Union County, just north of the cypress swamps, averaged 1.79 during the same period. The cypress swamps themselves would probably have shown a greater density in catch.

The Lake County habitat is characterized by marshes, shallow lakes of glacial origin, little timberland and large muskrat populations; Union County, by much heavy timber, numerous small creeks and springs, steep bluffs and a low muskrat population. The cypress swamps are even more heavily forested, but without bluffs and muskrats, and with but few springs. Comparable populations in such widely diverse habitats, in addition to general distribution in every county in Illinois, indicate great adaptability in minks and suggest that the species may long remain one of the more important fur animals of the state.

Ability to make use of almost any sort of cover in the vicinity of water gives the mink a great advantage over larger and more intolerant animals, such as the raccoon, figs. 23 and 24. The shore lines of streams, fig. 23, lakes, ponds and marshes; small runs and ravines, fig. 24; drifts, windfalls, brush, timberland and slashings: all afford mink cover. In the Glacial Lakes Region, marshy shore lines, stream banks and muskrat houses provide cover and denning areas. In the Gray Prairie Region, cattail-bordered mine ponds and small lakes, bogs and springs make up for the intermittent nature of the many small streams. In the vicinity of many of the ponds and springs there are thick slashings, the result of hasty logging of mine props, where a combination of brush, stump sprouts and second growth offers excellent mink cover. The Northwest Hills provide good forest cover and the Northwestern Sand Prairie contains considerable marsh area. Both regions have numerous small, permanent waterways; drainage ditches partly replace streams in the latter region. In the Black Prairie and Central Sand Prairie regions, lack of water is the greatest shortcoming; most of the streams and ditches, especially in dry years, are intermittent. During the fall of 1939 the water shortage in these two regions was serious, and probably accounts in part for the reduced mink yield.

Along the Illinois River, many minks live on or near wooded islands, isolated by marsh and shallow water. They den chiefly in hollow tree bases, especially willows, or in the ground, and in some cases muskrat trappers here are not aware of their presence, often in comparatively large numbers.

Trapping and Hunting.—Approximately 87 per cent of the Illinois mink catch was taken in traps during the two seasons of the survey. Many minks, especially along the Illinois and Mississippi rivers and in the Glacial Lakes Region, were taken in connection with muskrat trapping. Nearly all such minks were caught without the use of bait, trappers taking advantage of the mink's habit of traveling muskrat runs and entering muskrat houses and dens. Most bait sets were in shallow water and therefore operative only during nonfreezing weather. Other sets were made on logs, in narrow ditches and runs, and at points along waterways where minks were likely to step. Nearly all of the catch in the Glacial Lakes, Northwest Hills, Black Prairie and the Northwestern Sand Prairie regions was made by trappers.

About 13 per cent of the Illinois mink catch for the two seasons of the survey was by hunters. In the Central Sand Prairie in 1939-40, hunters accounted for 58 per cent of the catch. In no other

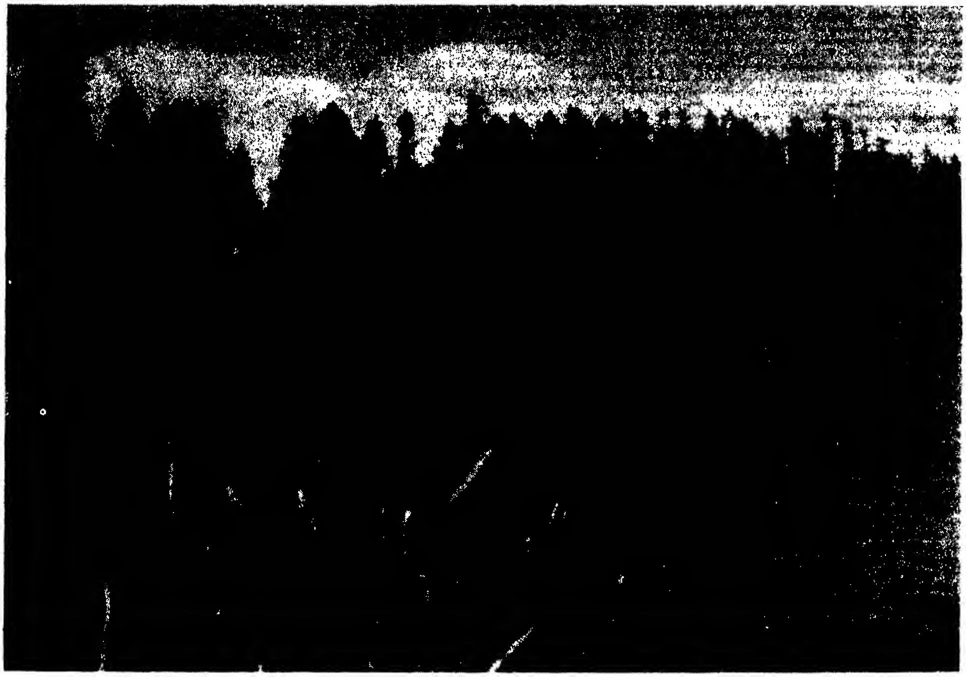

Fig. 21.—Minks are adaptable to habitats ranging from tamarack bogs in extreme northern Illinois to . . .

Fig. 22.— . . . swamps of cypress and tupelo gum in the southern tip of the state.

Fig. 23.—Saline River, Gallatin County. This forest-bordered stream illustrates one type of mink habitat common in the southern and southeastern parts of Illinois.

region did the hunter catch exceed 35 per cent. Both day and night hunting was practiced, the former being the favored method during tracking snows. Once the den was located, it was comparatively simple to dig the animal out, a practice now specifically prohibited by law. When sighted, such minks were usually shot with a small rifle or pistol, or were chased out to be caught by dogs. Occasionally, a good

Fig. 24.—Gibbon's Creek, Pope County. Rock-bottomed creeks such as this offer suitable mink range in southern Illinois.

dog would actually tree a mink and hold it long enough to be shot. More commonly, however, minks were "treed" in holes, windfalls, hollow snags or logs, or in piles of debris, and were taken by unstinted use of ax or spade. For the state as a whole, during the two survey seasons, about one-half of the trappers and one-fourth of the hunters were successful in taking minks, table 11.

Management.—A trapping season Nov. 15 to Jan. 15, or Dec. 1 to Jan. 31, is considered satisfactory for this species. Destruction of mink dens should be stopped, although the loss of ground dens is obviously less detrimental to minks than the cutting of den trees is to raccoons. A general program of habitat restoration featured by reforestation, erosion control, watershed protection and protection against fire and overgrazing would greatly benefit mink as well as other wildlife populations. Close pasturing of stream and ditch banks is very destructive to both mink and muskrat range. Drifts, debris, windfalls and brushy growths, where land use permits, provide very acceptable mink cover. Wide-scale mink control over large regions, in the interests of poultry or game, is inadvisable.

Long-Tailed Weasel

Two kinds of weasels are listed by Necker & Hatfield (1941) as occurring in Illinois. These are forms of the long-tailed and least weasel. The latter, of little or no importance in the fur trade, occurs in only a few of the northeastern counties, with one record from Lee County.

Unlike species of more general distribution over the state, such as the skunk and mink, the long-tailed weasel is concentrated principally in the more northern counties. It occurs, however, in every region, and in all is one of the less important fur animals. In 1938-39, the total calculated catch was 8,889, worth $3,111.15; in 1939-40, it was 8,796, worth $3,078.60, table 12. The decline in the second season was only about 6 per cent; all other species except the gray fox, which gained slightly in the second season, showed a greater catch decline than the weasel.

No long-tailed weasels appeared in the catch data from the Western Prairie in 1938-39, and the same was true of the Gray Prairie in 1939-40. While we are certain that the catch in these regions was very low, we are equally certain that a few of these animals were taken in the areas during the years for which there are blanks, table 12. These blanks suggest inaccuracies in the data, which a larger sample might have eliminated. In the Western Prairie Region, the calculated catch for the season in which the weasel was represented was only 0.04 per square mile, and in the Gray Prairie Region only 0.03 per square mile. The error therefore is small. The average pelt value of 35 cents, table 5, is only about one-third the price received for weasel skins at times during the previous decade.

Popularity.—The long-tailed weasel is usually considered one of the most undesired fur animals in Illinois. Trappers show little enthusiasm for weasels because their fur is of little worth and they may spoil sets made for foxes, minks and other more valuable species. Farmers and sportsmen consider them the worst mammalian enemies of poultry and game. Of a total of 124 answers concerning weasel popularity, 25 favored fewer weasels. Coming directly from fur-takers, these answers represent a positive indictment. Several years ago, when trappers commonly averaged $1 for long-tailed weasel pelts, they were an appreciated item. As determined in the survey, unpopularity was general, but most pronounced in the southern part of the state.

Damage and Control.—There is little question concerning the destructiveness of individual weasels. As a species, the long-tailed weasel may be considered bloodthirsty, and its reputation for ruthlessness in killing is well founded. It should be remembered, however, that this trait is exercised as readily and as vigorously on meadow mice as on chickens or ducks. Weasels kill thousands of rats and mice, and in some situations are good friends of the farmer. We recommend that destructive weasels be killed as promptly as possible and, in view of the low pelt value, without regard to season. Trapping is probably the most effective control, and traps set around a fresh kill are almost certain to make a catch.

Populations.—Nowhere in Illinois can the long-tailed weasel population be

considered dense. The heaviest catch for the two seasons of the survey was in the Glacial Lakes Region, where the yield averaged 0.82 weasel per square mile per year, table 12. The next heaviest catch was in the Northwestern Sand Prairie Region, with takes of 0.41 and 0.89 pelt per square mile in the two years. The Black Prairie yield was 0.23 and 0.15 pelt per square mile, mainly from the northern half of this region. In all other regions the catch was very low.

The writers have no explanation for the apparent regional fluctuation in the catch. Few trappers expressed an opinion on the changes in long-tailed weasel population. Of those who did for the season of 1938-39 as compared with the previous season, 28 reported an increase, 28 no change and 8 a decrease, table 12. With a continued poor demand for weasel furs and with normal populations of rodents and rabbits, it is reasonable to expect some increase in weasel numbers.

Habitats.—The long-tailed weasel is an upland furbearer. Rolling farms, pastures and brushland apparently provide the best Illinois habitats, figs. 5 and 25. Fencerows of shrubs or stone provide typical farmland den sites; dens may often be situated in the vicinity of farm outbuildings. Haystacks, brush piles and windfalls are also preferred units of the habitat, the animals probably being attracted to such places because of the abundance of mice. In the River Bluffs and Bottoms Region, weasels frequent the steeper hillsides as well as the farmed and pastured areas. In all regions, dense cover adjacent to fields or grassland provides favored range.

Fig. 25.—Rolling terrain and comparatively limited agricultural use of the land characterize the Northwest Hills Region. This and other northern Illinois regions produce most of the long-tailed weasels taken in the state.

Trapping.—Long-tailed weasel trapping is very simple and in Illinois is probably not deliberately practiced outside of the northern counties. A large part of the catch is incidental, especially in connection with skunk trapping. Weasels are readily attracted by fresh, bloody meat bait. Traps of small size, such as No. 1, are usually placed along fencerows, stone fences and piles, wood lots, brushy areas, ditches and creek banks. Very little, if any, of the catch is taken by hunting.

In the two-season survey, white weasels amounted to approximately 28 per cent of the calculated catch; a small percentage of the pelts were mixed, and by far the largest percentage were brown. Lake County, with 36 per cent, showed the largest percentage of white pelts. The

Table 12.—Weasel in Illinois: Calculated catch, income, trapping and hunting data, fluctuation in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Weasels	Per Cent of Hunters Taking Weasels	Per Cent Taken By: Trappers	Per Cent Taken By: Hunters	Number of Fur-Takers Reporting on Weasel Populations: Increase	No Change	Decrease	Number of Fur-Takers Desiring: More Weasels	Fewer Weasels
Northwest Hills	1938–39	49	0.06	$ 17.15	$0.02	8	0	100	0	0	1	1	4	1
	1939–40	148	0.18	51.80	0.06	15	0	100	0	2	4	0	4	2
Western Prairie	1938–39	—	—	—	—	—	—	—	—	0	0	0	0	0
	1939–40	130	0.04	45.50	0.01	6	0	100	0	0	3	0	2	1
River Bluffs and Bottoms	1938–39	1,350	0.12	472.50	0.04	9	0	100	0	1	8	0	6	3
	1939–40	450	0.04	157.50	0.01	5	0	100	0	1	1	1	5	1
Northwestern Sand Prairie	1938–39	1,856	0.41	649.60	0.14	21	0	100	0	14	0	0	4	4
	1939–40	4,028	0.89	1,409.80	0.31	48	0	100	0	19	5	0	21	1
Glacial Lakes	1938–39	1,343	0.82	470.05	0.29	39	0	100	0	8	16	0	9	6
	1939–40	1,343	0.82	470.05	0.29	31	0	100	0	9	7	2	27	1
Black Prairie	1938–39	3,786	0.23	1,325.10	0.08	13	0	100	0	5	1	0	0	2
	1939–40	2,469	0.15	864.15	0.05	13	0	100	0	2	6	0	2	2
Central Sand Prairie	1938–39	114	0.02	39.90	0.01	4	0	100	0	0	1	0	1	0
	1939–40	228	0.04	79.80	0.01	5	0	100	0	0	1	1	0	0
Gray Prairie	1938–39	391	0.03	136.85	0.01	8	0	100	0	0	1	7	12	1
	1939–40	—	—	—	—	—	—	—	—	0	0	0	2	0
Illinois	1938–39	8,889	0.16	$3,111.15	$0.05	12	0	100	0	28	28	8	36	17
	1939–40	8,796	0.15	$3,078.60	$0.05	14	0	100	0	33	27	4	63	8

proportion decreased progressively southward, white weasels being rare in central Illinois.

Management.—A season opening Dec. 1 and closing Jan. 31 is satisfactory for maintaining the present long-tailed weasel population.

Red Fox

According to Bailey (1936), two varieties of the red fox occur in Illinois. These are the northern plains red fox, *Vulpes fulva regalis* Merriam, and the eastern red fox, *Vulpes fulva fulva* (Desmarest). The range of the two subspecies overlaps, particularly in the northern part of the state. Necker & Hatfield (1941) list only *Vulpes fulva* Desmarest.

The red fox occurs throughout the state. In the seasons of the survey it ranked seventh in number of pelts and sixth in value, table 20. In 1938-39, the calculated catch was 10,674 pelts, worth $32,022; in 1939-40 it was 6,688 pelts, worth $18,392, table 13. These numbers represent only 0.76 per cent of the total fur catch over the 2-year period, table 20. During the first year, red fox pelts averaged about $3.00 each, and during the second, about $2.75 each, table 5, or about one-fourth of the 1924-29 value.

Popularity.—In Illinois, the red fox is one of the most controversial fur animals. Here, as elsewhere, it commands a great deal of public interest. In many southern Illinois localities, it is regarded highly as a sporting animal, and in many northern parts of the state it is vigorously condemned as a pest. Because of its mice- and rabbit-destroying tendencies, it is looked upon with favor by orchardists in the southern zone, where it has had the legal status of most other fur animals. In the northern zone, it was unprotected in both years of the survey and might be hunted and killed at any time. Several counties in the northern zone recently offered bounties of $2 for adults and $1 for pups. In the central zone, the red fox was protected in 1939-40 but not in 1938-39. Due to increasing numbers, red foxes are in many parts of the state growing in popularity with day hunters who may "walk them up" or hunt them with dogs.

Farmers and upland game hunters dislike the red fox because of its actual and alleged depredations on poultry, quails and pheasants. On the other hand, in certain southern localities, the activities of fox-hunting clubs over a period of many years have instilled in the public mind a respect for the species. In such localities, persons of differing opinion act and express themselves privately; and trappers in such communities do not readily report their fox catches.

Of the answers received from fur-takers contacted in the two seasons of the survey, a total of 239 favored more and 78 favored fewer red foxes. Non-fur-takers are known to be emphatic in their opposition to more red foxes. In comparison with the attitude toward the mink and muskrat, this degree of unpopularity may be considered an indictment against the species. Most fur-takers and all trappers valued the red fox in terms of income and desired to see it protected during months of the year in which its fur is of no value. It is apparent that the species suffers through lack of accurate, widespread knowledge concerning its food habits. Under present conditions it happens too often that the harm foxes do lives on, while their beneficial traits go unnoticed and unknown.

Damage and Control.—Complaints concerning the loss to foxes of small pigs, as well as poultry and game birds, are frequently heard. During the survey, many complaints involving fox depredations on chickens were received. It was, however, difficult to obtain specific cases of extensive damage. Some farmers and many sportsmen advised that they killed foxes at every opportunity; other farmers thought highly of fox-hunting clubs in the belief that they kept the foxes off their property.

In appraising actual damage, it seems safe to state that foxes take poultry, and to a lesser degree pigs, rather generally over the state, but only in a very few cases are the animals a serious menace to poultry or stock raising. The predation of foxes on game birds has been studied only locally, and is subject to so many variables that no statewide evaluation of this controversial issue can be made. In one Michigan locality, Dearborn (1932) found that mammals, chiefly rabbits and mice, made up over 40 per cent of the summer food of red foxes in 1930 and

Table 13.—Red fox in Illinois: Calculated catch, income, trapping and hunting data, fluctuations in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Red Foxes	Per Cent of Hunters Taking Red Foxes	Per Cent Taken By: Trappers	Per Cent Taken By: Hunters	Number of Fur-Takers Reporting on Red Fox Populations: Increase	No Change	Decrease	Number of Fur-Takers Desiring: More Red Foxes	Fewer Red Foxes
Northwest Hills	1938–39	131	0.16	$ 393.00	$0.48	9	33	39	61	5	1	5	11	4
	1939–40	74	0.09	203.50	0.25	9	20	43	57	2	2	6	9	4
Western Prairie	1938–39	260	0.08	780.00	0.24	6	9	44	56	3	1	0	6	0
	1939–40	292	0.09	803.00	0.25	0	10	0	100	3	0	2	10	0
River Bluffs and Bottoms	1938–39	3,263	0.29	9,789.00	0.87	20	9	69	31	23	3	1	25	21
	1939–40	3,375	0.30	9,281.25	0.82	19	11	49	51	25	4	3	30	14
Northwestern Sand Prairie	1938–39	860	0.19	2,580.00	0.57	6	41	19	81	18	0	0	8	6
	1939–40	317	0.07	871.75	0.19	4	36	37	63	2	7	1	22	2
Glacial Lakes	1938–39	—	—	—	—	0	0	0	1	1	0	0	22	0
	1939–40	16	0.01	44.00	0.03	—	33	100	0	0	0	0	26	1
Black Prairie	1938–39	4,116	0.25	12,348.00	0.75	5	66	14	86	6	2	0	15	1
	1939–40	823	0.05	2,263.25	0.14	6	50	80	20	1	1	2	9	3
Central Sand Prairie	1938–39	741	0.13	2,223.00	0.39	3	15	39	61	2	1	0	0	3
	1939–40	228	0.04	627.00	0.11	2	16	25	75	1	0	2	5	0
Gray Prairie	1938–39	1,303	0.10	3,909.00	0.30	11	2	95	5	12	0	0	20	9
	1939–40	1,563	0.12	4,298.25	0.33	11	4	89	11	15	1	1	21	10
Illinois	1938–39	10,674	0.19	$32,022.00	$0.57	8	14	49	51	70	8	6	107	44
	1939–40	6,688	0.12	$18,392.00	$0.32	7	13	53	47	49	15	17	132	34

over 90 per cent in 1931. Other workers have reported similar findings. Predation on game is probably rather general, but, except perhaps locally, it is doubtful if foxes ever threaten game populations with extermination. Foxes are most destructive during the spring months when foraging for their young; at all seasons availability of prey largely determines the kind of food and the degree to which it may be taken (Errington 1937*a*). One of the best ways of protecting poultry, therefore, is to keep it out of the fields and woods.

Trapping and hunting are recommended as the best means of controlling red foxes; a well-trained dog will keep all foxes at a distance. The use of poison and gas, now illegal against fur animals in Illinois, is not recommended at any time. The payment of bounties and the killing of animals when the pelts are valueless invariably result in waste of money and valuable furs. It should not be forgotten that one or more prime fox pelts per year may cover, or more than cover, predation losses on the average farm. In the necessity of reducing fox populations over sizable areas, more intensive hunting and trapping are suggested during the winter months when the fur is prime. During the trapping season local trappers often gladly aid in control.

Populations.—In the opinion of numerous experienced trappers, an increase in the red fox population became apparent about 1931, and a peak was reached in 1934-35. Since that time the population seems to have remained relatively stable except for minor or local fluctuations. The high 1938-39 catch probably does not represent a peak year in either value or number of pelts, for the following reasons: low fur price, better employment than during the depression years and the generally prosperous condition of agriculture, especially in the corn belt. In 1939-40, the decreased catch of about 37 per cent below that of the preceding year may indicate a cyclic reduction in numbers. Of a total of 165 expressions of opinion from fur-takers, 119 indicated a recent increase in red fox numbers, 23 no change and 23 a decrease.

Every region was represented in the catch during the survey, but the Glacial Lakes catch was extremely low, only 0.01 red fox per square mile in 1939-40. Red foxes were not represented in the data for this region the preceding year. The heaviest catch, 0.29 and 0.30 pelt per square mile, was taken in the River Bluffs and Bottoms Region. Thus, in no region did the catch average as much as one red fox per 3 square miles. The red fox and the weasel have lower averages for the state as a whole than any other fur animals except the gray fox and other species that do not have state-wide distribution.

Habitats.—Catch figures indicate that the best red fox habitat in Illinois is offered by the River Bluffs and Bottoms Region, and the second best by the Black Prairie. The cover of the first region, with its timber, brushland, bluffs and steep narrow ravines, irregularly interspersed with fields and pastures, should be expected to provide good habitat, fig. 26. Cover on the Black Prairie is furnished chiefly by timbered bottomland, woodlots and waste areas such as strip-mines and abandoned gravel pits. Strip-mines in Fulton and Vermilion counties are known to hold comparatively large numbers of red foxes. Hunters, on snow, often jump foxes in daytime in open fields. The intermittent nature of streams in the Gray Prairie, Central Sand Prairie and many parts of the Black Prairie lowers the general quality of the habitat in these regions. As reflected in the catch, the Glacial Lakes offers the poorest red fox range, but this indication is hard to reconcile with the known cover, water and food resources of the region. So far as the writers are aware, red foxes here are not accorded special protection by fox clubs or other organizations. It seems probable that the method of trapping, wherein a great majority of the sets are made for muskrats and minks, precludes the taking of many foxes. Because of low price, little deliberate fox trapping was done anywhere in the state during the survey years.

Trapping and Hunting.—Approximately one-half of the Illinois red fox catch was made by trappers and one-half by hunters, as determined in the survey, table 13. The degree of both trapping and hunting, however, varied widely by regions. Trapping predominated in the Gray Prairie and Glacial Lakes regions; hunting was the more common method of capture in the Northwestern Sand Prairie, the Central Sand Prairie and the

Fig. 26.—Good red fox range in the Ozark foothills, Hardin County, Shawnee National Forest. This is in the River Bluffs and Bottoms Region.

Northwest Hills regions. In other regions both methods were employed about equally, but with wide variations by years. For example, in the Black Prairie, trappers took only 14 per cent of the red foxes in 1938-39, but 80 per cent the next year. A somewhat similar situation was noted in the River Bluffs and Bottoms Region.

No attempt will be made here to give an account of fox hunting in Illinois. Its devotees are fully as enthusiastic as those who pursue the coon, and the chase itself is probably even more of a social event. Fox hunters are typically "crony" groups, often rivals in other walks of life but able to find common ground in baying dogs, camp fires, stimulants and stories. Fox hunting is one of the great American traditions, and a diversion in which the recreational returns far outweigh any monetary value of the furs. Farmers and business men, rural and urban dwellers, make up the membership of practically all fox-hunting clubs. Fox hunts or fox drives, staged in daytime, are becoming very common in the Black Prairie Region.

Fox trapping is probably the best example of the trapper's art. Few species are credited with more intelligence than foxes in avoiding traps, and years of experience seem to be necessary before a trapper acquires the status of a fox expert. Successful trappers use both baited and nonbaited sets. Traps placed in trails, gaps in woven wire fences, on mounds overlooking some natural food or lure are often successful. When bait is employed, it is commonly buried around a stump or rock and traps placed in the freshly excavated soil. Many successful sets are made on or around old straw stacks.

Fox hunters often strenuously oppose the use of traps for foxes, as well as other animals, because of the possibility of catching dogs.

Management.—A few foxes "go a long way." In farm communities there is more danger of red foxes becoming too numerous than of probably any other fur species. Since the population trend in Illinois during recent years has been upward, there is no need of protection beyond that normally accorded to other fur animals in this state. Indeed, it may become desirable to reduce local red fox populations, and increased hunting and trapping in season is the method recommended. We feel that bounties are not effective in control and that they may encourage bootlegging of fox furs and other undesirable practices. The destruction of adult foxes and pups during the summer months results in waste and should be discouraged except in cases where animals of known guilt are involved.

For most years, an open season coincid-

ing with that for all other fur animals, with control based on more intensive hunting and trapping in season, offers the simplest plan of management, and one fair to hunters and trappers alike. An unprotected status of the species in the northern and central zones may be justified in periods of a decidedly upward trend in red fox populations. The period for dog training should coincide with that recommended for coon dogs, Sept. 15 through Jan. 31, and for the same reason.

Gray Fox

The gray fox is essentially a timberland species, and in Illinois in the two seasons of the survey was found in greatest density in the River Bluffs and Bottoms Region, fig. 27. Here the calculated catch averaged 0.35 pelt per square mile in 1938-39 and 0.42 per square mile in 1939-40, table 14. The Northwest Hills ranked second in catch density, with an average of 0.29 and 0.20 pelt per square mile in 1938-39 and 1939-40, respectively. The Northwestern Sand Prairie and the Glacial Lakes, with trace yields averaging 0.03 and 0.01 pelt per square mile, respectively, were represented only in 1938-39. The survey indicated that the species appeared in the catch only in these four regions. In 1938-39, the calculated catch of gray foxes was 4,328, worth $7,574.00; in 1939-40, 4,889, worth $8,555.75, table 14. Gray foxes ranked eighth in the catch for these two seasons, table 20. The average price for these years of $1.75 per pelt, table 5, may be considered lower than normal.

Popularity.—The gray fox is generally unpopular. It lacks the sporting qualities of the red fox, and in the public mind it is a serious predator on poultry and game. Fur-takers are indifferent because of the low pelt value. Of the total of 142 opinions expressed by trappers and hunters, 92 favored more and 50 fewer animals. Thus, the gray fox, along with the opossum and coyote, ranks very low in the estimation of Illinois fur-takers.

Damage and Control.—The remarks made under this heading for the red fox are generally applicable to the gray fox. Some persons regard the gray fox more destructive to game, particularly forest game, than the red fox.

Populations.—The data at hand indi-

Fig. 27.—The gray fox is typically a forest-inhabiting species. The foothill and river bluff types of Union County offer excellent range for this fox.

Table 14.—Gray fox in Illinois: Calculated catch, income, trapping and hunting data, fluctuations in population, and popularity, 1938-39 and 1939-40.

Fur Survey Region	Season	Calculated Total Catch	Average Catch Per Square Mile	Calculated Total Income	Average Income Per Square Mile	Per Cent of Trappers Taking Gray Foxes	Per Cent of Hunters Taking Gray Foxes	Per Cent Taken By		Number of Fur-Takers Reporting on Gray Fox Populations			Number of Fur-Takers Desiring	
								Trappers	Hunters	Increase	No Change	Decrease	More Gray Foxes	Fewer Gray Foxes
	1938–39	238	0.29	$ 416.50	$0.51	19	17	65	35	6	0	3	8	4
Northwest Hills	1939–40	164	0.20	287.00	0.35	21	20	81	19	3	4	4	7	5
	1938–39	3,938	0.35	6,891.50	0.61	29	16	94	6	12	1	3	11	23
River Bluffs and Bottoms	1939–40	4,725	0.42	8,268.75	0.73	33	7	87	13	25	3	0	20	16
	1938–39	136	0.03	238.00	0.05	2	16	33	67	12	1	1	7	2
Northwestern Sand Prairie	1939–40	—	—	—	—	—	—	—	—	—	—	—	—	—
	1938–39	16	0.01	28.00	0.02	1	0	100	0	2	0	0	22	0
Glacial Lakes	1939–40	—	—	—	—	—	—	—	—	—	—	—	17	0
	1938–39	4,328	0.08	$7,574.00	$0.13	13	3	92	8	32	2	7	48	29
Illinois	1939–40	4,889	0.09	$8,555.75	$0.15	6	3	86	14	28	7	4	44	21

cate a slight increase in the gray fox population in 1939-40 over that of the preceding year; thus, this species was the only one to show an increase during the period covered by the study. In the River Bluffs and Bottoms, gray foxes appear to be more numerous than red foxes and in favored localities may show a ratio of two to one over the reds. In the regions from which catches were recorded, the gray fox showed an average catch for the survey period of about 0.26 pelt per square mile as compared with slightly less than 0.16 for the red fox, but for the state as a whole the red fox catch was approximately twice as heavy, being almost 0.16 per square mile compared with about 0.08 per square mile for the gray fox, tables 13 and 14.

In the Northwest Hills and River Bluffs and Bottoms regions, the only two in which the gray fox was plentiful, there was comparatively little variation in the population as indicated solely by catch in the two survey seasons. Red fox catches in four regions indicated great differences in numbers between the two seasons, table 13. It may be that the gray fox is less cyclic, but on the basis of data at hand such a statement represents little more than speculation. Higher fur prices would undoubtedly have resulted in larger catches, and for this reason it is impossible to estimate population on catch alone. It is certain that the gray fox occurs over a larger area and in greater numbers than indicated by survey data.

Habitats.—The gray fox range in Illinois is not decreasing as rapidly as formerly, because of the fact that many brush areas, refuges and forest preserves now occupy lands once farmed or subject to lumbering operations. The best gray fox habitat in Illinois is in the River Bluffs and Bottoms Region, which is characterized by heavy timber stands, underbrush, rock outcrops and deep, shady ravines, fig. 26. The Northwest Hills and the Northwestern Sand Prairie offer similar habitats. The Glacial Lakes Region is more parklike and lacks rock outcrops. Why no gray foxes were reported in the catch from the comparatively well-wooded Gray Prairie Region is not known. Distribution of the gray fox, as indicated by the survey, is principally over the northern half of the state, except for the River Bluffs and Bottoms Region. This fox, to a greater degree than the red fox, is intolerant of man and cultivation.

Food for the gray fox in all its habitats is probably ample, consisting of rabbits, mice, birds, insects and fruits. The persimmon is said to be important in regions where it occurs.

Trapping and Hunting. — Over three-fourths of the Illinois gray foxes were taken by trappers and less than one-fourth by hunters in the years of the survey. There is little deliberate attempt in this state to take them in traps; most are incidentally captured in sets made for red foxes, skunks and other land species. Trappers specifically trying for them employ methods similar to those used for the red fox.

Gray fox hunting offers little of the excitement characteristic of red fox hunting. Chases seldom last more than 30 minutes and often not long enough to allow the hunter to make a stand. Gray foxes are sometimes treed in bushy or inclined trees, from which they are easily shot.

Management. — Suggestions given under this heading for the red fox are generally suitable for the gray fox.

Badger

Badgers occurred in low numbers over the Northwest Hills and the Northwestern Sand Prairie Regions in 1938-39 and 1939-40. Probably at no point in the state could they be considered common. Although the Illinois game codes of 1937 and 1939 appear to have provided full protection for badgers, a common interpretation of the statutes was such that these animals were hunted and trapped through at least the season of 1938-39. The survey indicated that 116 were taken in 1938-39, but only 8 in 1939-40. Although these data are not considered reliable, the reduction in 1939-40 suggests that the correct interpretation of the law, and an appreciable measure of protection, began about this time. The game code put into effect in 1941 clarified the provision that accorded to badgers a year-around closed season.

The low price of badger fur, averaging only about 75 cents per pelt for several years prior to 1941, restricted the catch, and probably was important in prevent-

ing complete extirpation of the species from the state.

Badgers are generally considered a nuisance, and little appreciation accrues from their rodent-destroying value. Their dens constitute a hazard to livestock, and their ability to fight when cornered results in the crippling of dogs. Trappers in this state found them hard to hold, tough to skin and unprofitable, because most Illinois badgers have the coarse, "hair-badger" type of pelt. For these reasons there was little deliberate effort to trap them even in the years when badger trapping was legal, and hunters sought to avoid badgers because of the resultant fights and maiming of their dogs. Most of the badgers were taken incidentally to trapping for other animals. Still-hunters accounted for a part of the take. Traps set at the entrance of dens, mistaken by trappers for those of skunks, were most productive and a large part of the badger catch was so made.

Fig. 28.—Horseshoe Lake, Alexander County. This and other oxbow lakes along the Mississippi, Illinois and Ohio rivers, supplying food, water and relative seclusion, offer potential if not actual otter range.

The most suitable badger habitat in Illinois appears to be rolling, sandy grassland prairie. Here the animals dig innumerable dens and holes, partly in pursuit of rodents. Such activities may destroy some pasture area, in addition to being the cause of occasional broken legs among horses and cattle. In some localities, and in certain years, control measures in the form of gassing and poisoned bait, now illegal, undoubtedly resulted in some decrease in the badger population as well as that of skunk, woodchuck and other mammal species.

In view of the scarcity of the badger, the writers believe it to be worthy of full protection except under such circumstances as make control imperative.

Coyote

The coyote, according to Gregory (1936), was once plentiful in the Chicago region, later practically extirpated, "and only recently beginning to appear occasionally." Its present population in the state is very low, and, as determined by the survey, it appeared in the fur catch only in the Northwestern Sand Prairie. It is, however, known to occur in other regions of the state. The tendency of the coyote to cross with dogs complicates its status considerably and partly accounts for the frequent reports of its occurrence. In many instances where such reports have been checked it was found that the animal involved was a police dog, or occasionally some other kind. A number

of records of recent date are given in the Mohr report.

In its present numbers, coyotes in themselves constitute little or no problem in Illinois, and many of the complaints popularly associated with them are in reality associated with wild or free-ranging dogs. In the event that coyotes become numerous, control measures may of course become necessary; any contemplated statutes and action relative to control of coyotes should include wild dogs.

The catch of 91 coyotes calculated for 1938-39 is believed to be based on too few data to be reliable. A catch of 25 per year is considered much more likely.

Otter

The otter, if not actually extirpated from Illinois, is present only in straggling numbers. The most recent records for the state are given in the Mohr report. This species has probably been of no appreciable importance in the Illinois fur trade since about 1900.

In view of the several large rivers in and bounding the state, and particularly the large backwaters along the Illinois and Mississippi rivers that have formed behind navigation dams, there is undoubtedly some suitable otter range in the state, fig. 28. Numerous deep, wooded, clear-water sloughs making up part of such backwaters offer ample food, water and seclusion. With continued protection, which fortunately has been given this species since 1929, it would not be surprising to see otters regain a part of their former Illinois range. It is not considered likely, however, that they will appear in sufficient numbers, at least in the near future, to justify an open season.

Beaver

The beaver has been of no appreciable importance in the Illinois fur trade since about 1850. This species was completely extirpated in the state some time after Forbes (1912) had reported on the native animal resources of Illinois. It was reintroduced in 1935, and now appears to be established in Pope and Union counties. An account of beaver restocking, increase and spread is given in the Mohr report.

Except in certain southern Illinois lo-

Fig. 29.—Beaver lodge at Wolf Lake, Union County, 1939. This bottomland stand of soft maple, cottonwood and willow was flooded in 1938.

calities, because of agricultural interests there is little potential beaver range in the state. In the more heavily forested counties, however, particularly where small streams or lakes, and cottonwood, willow, soft maple and other hardwood stands occur, the beaver would find a limited amount of permanent habitat. One well-used beaver habitat was created in Union County by flooding a small hardwood timbered bottom, fig. 29. It is not improbable that cottonwood- and willow-bordered stripmine lakes would support beavers. There is, of course, no likelihood of this species regaining its former importance in the state.

Bobcat

The bobcat, or wildcat, is another Illinois mammal now found in very low numbers. Decimation was rapid after 1910 because bobcats offer exciting sport, are condemned as destructive predators by farmers and many sportsmen, and require a semiwilderness habitat. The logging of cypress swamps in the southern tip of the state probably destroyed the last good bobcat range in Illinois. In several southern Illinois counties where sizable areas of forests and bluffs are found, fig. 30, bobcats may still occur in very low numbers or, in the event of suitable protection, they may appear there in the future. Several bobcats were reported taken in Alexander and Jackson counties in 1942, from the forest-bluffs habitat along the Mississippi River. In view of the general absence of suitable range, it is likely that bobcats will never regain their former status, even in the more heavily timbered parts of the state. Other recent records of bobcat occurrence in Illinois are given in the Mohr report.

Bobcats, because of the very low value of the fur, have never been of any appreciable importance in the fur trade, Illinois or elsewhere.

Fig. 30.—An example of Illinois terrain, Pope County, suitable for bobcat range. Semiwilderness forests and broken terrain offer territory attractive to this species.

House Cat

The house cat is now one of the most abundant carnivores in Illinois, as in many other states. Its ecological influence has never been adequately studied, but that it is an important predator in farm regions can hardly be doubted. No close estimate of the Illinois house cat population is made here, but one per household, rural and urban, is not an exaggeration. This would amount to over 1,500,000 cats, of which at least half are free to range over game-

producing areas. It is certain that a very large number of rodents are destroyed by these cats, and equally certain that thousands of song and game birds and rabbits are also destroyed. The fur, while salable for a few cents per pelt, is of practically no importance in the trade. This circumstance further disqualifies the species as a worthy member of the fauna.

The writers recommend strongly a material reduction of the free-ranging house cat population and suggest shooting and trapping by conservation officials, sportsmen and trappers as the best method of effecting such reduction.

TOTAL YIELD AND VALUE

The foregoing sections have given in some detail the yield and value of each important Illinois fur animal during the two seasons covered by the survey. The discussion is continued in the following paragraphs, but with all species grouped and the state considered as a unit. For convenience and brevity, much of this information is presented in tables.

Any consideration of the yield and value of the total fur resource of Illinois should be prefaced by a discussion of fur prices. The average prices of the seven most important Illinois raw furs, 1909 through 1942, is shown in fig. 31. With the exception of those for minks, prices during the seasons of 1938-39 and 1939-40 were about equal to, or at least not far above, those prevailing during the worst years of the recent depression. Based on the opinions of hundreds of Illinois furtakers, the fur catch has steadily declined

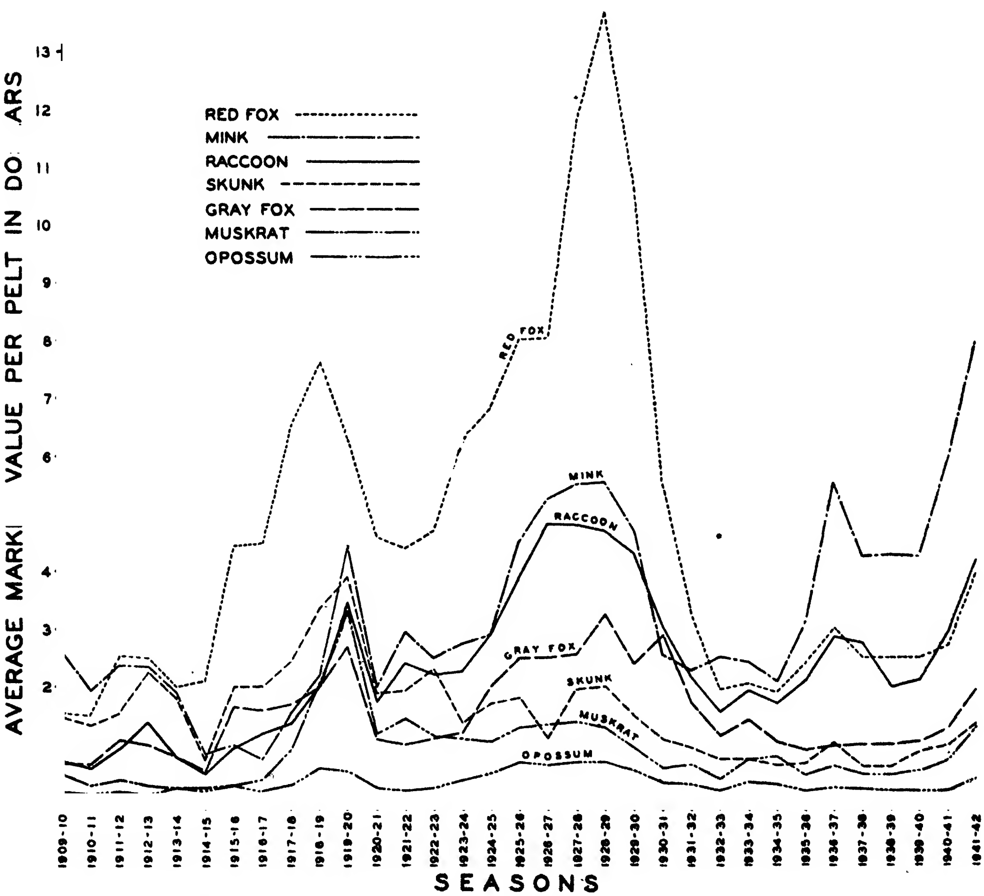

Fig. 31.—Average raw fur prices, Central States, for seven important species, 1909-10 through 1941-42. Sources of data: 1909-35, St. Louis *Globe-Democrat*, as adapted from Bennitt & Nagel (1937); 1935-42, *Fur-Fish-Game* raw fur market averages for No. 1 medium pelts.

Table 15.—Calculated Illinois fur catch (number of pelts) by species in the eight fur survey regions and in the entire state, 1938-39 and 1939-40.

Species	Northwest Hills		Western Prairie		River Bluffs and Bottoms		Northwestern Sand Prairie		Glacial Lakes		Black Prairie		Central Sand Prairie		Gray Prairie		Illinois	
	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40
Muskrat..	8,859	11,584	15,539	18,783	25,990	20,927	110,389	115,594	97,346	71,826	464,722	304,712	113,484	89,101	48,066	32,304	884,395	664,831
Opossum..	1,330	1,002	13,398	14,566	136,587	83,257	7,423	10,772	2,539	2,228	14,322	10,700	11,850	8,033	56,793	41,032	244,242	171,590
Mink.....	714	747	2,984	3,958	19,127	13,501	3,213	4,390	4,406	4,521	8,560	5,926	1,823	2,051	12,896	10,160	53,723	45,254
Skunk....	846	1,174	1,882	2,044	13,839	12,939	2,942	5,160	1,523	885	19,425	6,420	2,279	2,849	6,904	5,210	49,640	36,681
Raccoon..	665	690	2,563	3,504	21,714	17,439	2,489	2,444	344	475	1,482	1,152	4,558	3,532	8,597	5,341	42,412	34,577
Weasel....	49	148	—	130	1,350	450	1,856	4,028	1,343	1,343	3,786	2,469	114	228	391	—	8,889	8,796
Red fox...	131	74	260	292	3,263	3,375	860	317	—	16	4,116	823	741	228	1,303	1,563	10,674	6,688
Gray fox..	238	164	—	—	3,938	4,725	136	—	16	—	—	—	—	—	—	—	4,328	4,889
Totals...	12,832	15,583	36,626	43,277	225,808	156,613	129,308	142,705	107,517	81,294	516,413	332,202	134,849	106,022	134,950	95,610	1,298,303	973,306
Average per season...	14,207.5		39,951.5		191,210.5		136,006.5		94,405.5		424,307.5		120,435.5		115,280		1,135,804.5	
Per cent of average catch...	1.25		3.52		16.83		11.98		8.31		37.36		10.60		10.15		100.00	

Table 16.—Calculated average fur yield (number of pelts) per square mile by species in 10 sample counties representing the eight fur survey regions in Illinois, 1938-39 and 1939-40.

Species	Northwest Hills		Western Prairie		River Bluffs and Bottoms				Northwestern Sand Prairie		Glacial Lakes		Black Prairie		Central Sand Prairie		Gray Prairie			
	Jo Daviess		Hancock		Calhoun		Union		Lee		Lake		Champaign		Mason		Franklin		Jasper	
	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939–40	1938–39	1939 40	1938–39	1939–40
Muskrat.........	10.79	14.11	4.79	5.79	2.30	2.64	2.31	1.31	24.39	25.54	59.43	43.85	28.23	18.51	19.92	15.64	3.20	2.19	4.22	2.78
Opossum........	1.62	1.22	4.13	4.49	16.39	9.88	9.12	5.64	1.64	2.38	1.55	1.36	0.87	0.65	2.08	1.41	3.36	2.99	5.40	3.32
Raccoon.........	0.81	0.84	0.79	1.08	2.66	1.84	1.41	1.34	0.55	0.54	0.21	0.29	0.09	0.07	0.80	0.62	0.67	0.39	0.66	0.42
Skunk...........	1.03	1.43	0.58	0.63	1.09	1.09	1.38	1.20	0.65	1.14	0.93	0.54	1.18	0.39	0.40	0.50	0.13	0.09	0.96	0.72
Mink............	0.87	0.91	0.92	1.22	1.20	0.75	2.06	1.52	0.71	0.97	2.69	2.76	0.52	0.36	0.32	0.36	1.15	0.76	0.84	0.80
Red fox.........	0.16	0.09	0.08	0.09	0.42	0.38	0.21	0.23	0.19	0.07	—	0.01	0.25	0.05	0.13	0.04	0.01	0.01	0.19	0.23
Gray fox........	0.29	0.20	—	—	0.08	0.06	0.54	0.68	0.03	—	0.01	—	—	—	—	—	—	—	—	—
Weasel..........	0.06	0.18	—	0.04	0.09	0.02	0.14	0.07	0.41	0.89	0.82	0.82	0.23	0.15	0.02	0.04	0.02	—	0.05	—
Badger..........	0.03	0.01	—	—	—	—	—	—	0.02	—	—	—	—	—	—	—	—	—	—	—
Coyote..........	—	—	—	—	—	—	—	—	0.02	—	—	—	—	—	—	—	—	—	—	—

Table 17.—Composition of calculated Illinois fur catch, expressed for each region and each important species as per cent of total catch for 1938-39 and 1939-40.

Fur Survey Region	Musk-rat	Opos-sum	Mink	Skunk	Rac-coon	Weasel	Red Fox	Gray Fox	Per Cent of Total Catch
Northwest Hills	71.94	8.21	5.14	7.11	4.77	0.69	0.72	1.42	1.25
Western Prairie	42.96	35.00	8.69	4.91	7.59	0.16	0.69	0.00	3.52
River Bluffs and Bottoms	12.27	57.49	8.53	7.00	10.24	0.46	1.74	2.27	16.83
Northwestern Sand Prairie	83.08	6.69	2.80	2.98	1.81	2.16	0.43	0.05	11.98
Glacial Lakes	89.60	2.52	4.73	1.28	0.43	1.42	0.01	0.01	8.31
Black Prairie	90.66	2.95	1.71	3.05	0.31	0.74	0.58	0.00	37.36
Central Sand Prairie	84.11	8.25	1.61	2.13	3.36	0.14	0.40	0.00	10.60
Gray Prairie	34.86	42.43	10.00	5.25	6.05	0.17	1.24	0.00	10.15
Per Cent of Total Catch	68.19	18.31	4.36	3.80	3.39	0.78	0.76	0.41	100.00

during at least the last two decades. In about 1920, when catches were larger and prices as high or higher, the total annual worth of Illinois raw furs was undoubtedly in excess of the income shown for the seasons of 1938-39 and 1939-40.

Prices have a very important bearing on catches of certain species. Red fox pelts were unusually valuable during the period 1927-30, but by 1932 had dropped nearly to the value of raccoon pelts, resulting in greatly reduced hunting and trapping pressure on red foxes. This condition may explain in part the increase in the numbers of these foxes during the last decade. It is known that comparatively high red fox populations have prevailed since about 1933.

Despite low prices, the muskrat take has continued heavy since the era of high prices. This is due to the comparative abundance of the animals and the ease with which they are trapped and handled. The relatively high level of mink fur prices since 1935 is undoubtedly responsible in large measure for the severe reduction in numbers of this valuable species. Low prices during recent years on other furs, particularly on those of opossums and foxes, undoubtedly resulted in

Table 18.—Calculated value of Illinois raw furs per square mile in 10 sample counties, 1938-39 and 1939-40.

Fur Survey Region	Sample County	1938–39	1939–40	Average, 1938–40
Northwest Hills	Jo Daviess	$18.44	$23.58	$21.01
Western Prairie	Hancock	13.35	17.12	15.24
River Bluffs and Bottoms	Calhoun	21.11	15.04	18.08
	Union	23.55	17.31	20.43
Northwestern Sand Prairie	Lee	27.16	34.57	30.87
Glacial Lakes	Lake	70.54	62.12	66.33
Black Prairie	Champaign	28.29	21.52	24.90
Central Sand Prairie	Mason	20.89	19.95	20.42
Gray Prairie	Franklin	12.70	8.25	10.48
	Jasper	12.95	10.46	11.71

Table 19.—Calculated value of Illinois fur catch by species and regions, 1938-39 and 1939-40.

Fur Survey Region	Season	Muskrat	Opossum	Mink	Skunk	Raccoon	Weasel	Red Fox	Gray Fox	Total	Average Per Season	Per Cent of Average Annual Value
Northwest Hills	1938–39	$ 7,087.20	$ 266.00	$ 4,998.00	$ 634.50	$ 1,330.00	$ 17.15	$ 393.00	$ 416.50	$ 15,142.35	$ 17,252.53	1.44
	1939–40	11,584.00	200.40	4,482.00	1,174.00	1,380.00	51.80	203.50	287.00	19,362.70		
Western Prairie	1938–39	12,431.20	2,679.60	20,888.00	1,411.50	5,126.00	—	780.00	—	43,316.30	49,330.50	4.11
	1939–40	18,783.00	2,913.20	23,748.00	2,044.00	7,008.00	45.50	803.00	—	55,344.70		
River Bluffs and Bottoms	1938–39	20,782.00	27,317.40	133,889.00	10,379.25	43,428.00	472.50	9,789.00	6,891.50	252,948.65	218,528.78	18.19
	1939–40	20,927.00	16,651.40	81,006.00	12,939.00	34,878.00	157.50	9,281.25	8,268.75	184,108.90		
Northwestern Sand Prairie	1938–39	88,311.20	1,484.60	22,491.00	2,206.50	4,978.00	649.60	2,580.00	238.00	122,938.90	139,678.42	11.60
	1939–40	115,594.00	2,154.40	26,340.00	5,160.00	4,888.00	1,409.80	871.75	—	156,417.95		
Glacial Lakes	1938–39	77,876.80	407.80	30,842.00	1,142.25	688.00	470.05	—	28.00	111,554.90	106,650.77	8.87
	1939–40	71,826.00	445.60	27,126.00	885.00	950.00	470.05	44.00	—	101,746.65		
Black Prairie	1938–39	371,777.60	2,864.40	59,920.00	14,568.75	2,964.00	1,325.10	12,348.00	—	465,767.85	410,013.62	34.12
	1939–40	304,712.00	2,140.00	35,556.00	6,420.00	2,304.00	864.15	2,263.25	—	354,259.40		
Central Sand Prairie	1938–39	90,737.20	2,370.00	12,761.00	1,709.25	9,116.00	39.90	2,223.00	—	118,956.35	116,294.88	9.68
	1939–40	89,101.00	1,606.60	12,306.00	2,849.00	7,064.00	79.80	627.00	—	113,633.40		
Gray Prairie	1938–39	38,452.80	11,358.60	90,272.00	5,178.00	17,194.00	136.85	3,909.00	—	166,501.25	144,080.95	11.99
	1939–40	32,304.00	8,206.40	60,960.00	5,210.00	10,682.00	—	4,298.25	—	121,660.65		
Illinois	1938–39	$707,456.00	$48,848.40	$376,061.00	$37,230.00	$84,824.00	$3,111.15	$32.022.00	$7,574.00	$1,297,126.55	$1,201,830.45	100.00
	1939–40	664,831.00	34,318.00	271,524.00	36,681.00	69,154.00	3,078.60	18,392.00	8,555.75	1,106,534.35		

some increase in populations, but their net effect on these populations is difficult to evaluate. Studies of extended duration on representative areas are necessary before the full effect of prices and various other economic and social factors can be determined.

Of the factors other than price that may affect the fur catch, the most important are weather, employment and the degree of prosperity among rural people generally. The effect of both employment and rural prosperity is apparent; during industrial booms, especially in mining and lumbering, or during eras of good farm prices, potential trappers are not inclined to follow the uncertain recourse of fur-taking for a livelihood. This reference to farmer-trappers chiefly concerns tenants, share-croppers and small farm owners in southern or southwestern Illinois. Few landowners in the more prosperous farm regions give any time or thought to the fur crop, since it is insignificant in comparison with their main farm activities.

As discussed previously, there has been a pronounced decline in farm-boy trapping in Illinois. The skill of older professional trappers offers discouraging competition to boys, who are now concerned with school and related activities.

The effect of weather on the catch is highly important. Mild weather and open water usually result in increased catches, since traps placed on logs, in trails or at the edge of lakes and streams do not freeze down, and every night is a "catching" night. Extreme drought, resulting in dried-up water courses, serves to concentrate muskrats, minks, and probably other species, on areas where water is available. Under such conditions the bulk of the catch may be made by relatively few trappers, while fur-takers without trapping water often hang up their traps for the season or until heavy rains fall. Dry conditions also make for poor trailing and consequently low night catches of raccoons, opossums, foxes and other fur animals. Very deep snow, sleet and floods are also detrimental to good catches. Cold weather induces hibernation in raccoons and skunks, and reduced activity in certain other species. On the other hand, warm weather probably results in maximum travel on the part of fur animals and therefore increased chance of being taken in traps. Unseasonably warm weather may result in some spoilage of pelts. Under certain conditions, especially in the Glacial Lakes Region and on the Illinois River marshes, ice a few inches thick is conducive to good muskrat trapping.

In tables 15 and 16, respectively, the calculated total and average per-square-mile catch of Illinois furs is given by species and regions for both years covered by the survey. In table 17, these data are expressed in per cent for both species and regions, and for the state as a whole. In table 18, the calculated income value of the fur resource per square mile in sample counties is summarized; and, in table 19, the value is expressed in dollars for both species and regions, and in per cent for regions. Table 20, comparing catch with value, shows wide variation between total value and the total number of pelts for the various fur animal species. Similarity in percentages relating to catch and value for the same regions, tables 15 and 19, is due to compensating factors between number and average pelt value of species. The data in tables 16 and 19 are taken directly from the preceding tables dealing with specific animals.

The value of the fur resource in Illinois as given in table 19 for 1938-39 and 1939-40 is probably lower than the average annual income. How much lower it was than the average for the previous 20 years is not known. The total income for 1938-39 was \$1,297,126.55, as calculated from sample data; for 1939-40, \$1,106,-534.35, derived in the same manner. These data represent an average income of \$1,201,830.45 per season.

As stated in a previous section of this paper, the raw fur income is derived practically without investment or management, and at no harvesting expense except time and the cost of trappers' supplies. The investment, capitalized at 4 per cent, required to yield a comparable annual income may be calculated by using the standard formula:

$$\text{Capital} = \frac{\$1{,}201{,}830.45}{0.04},$$

or \$30,045,761.25

When the lower-than-average incomes of 1938-39 and 1939-40 are taken into

Table 20.—Calculated catch and value of Illinois furs for two seasons, 1938-39 and 1939-40.

Species	Catch		Value	
	Total Catch	Per Cent of Total Catch	Total Income	Per Cent of Total Income
Muskrat	1,549,226	68.19	$1,372,287.00	57.09
Mink	98,977	4.36	647,585.00	26.94
Raccoon	76,989	3.39	153,978.00	6.41
Opossum	415,832	18.31	83,166.40	3.46
Skunk	86,321	3.80	73,911.00	3.07
Red fox	17,362	0.76	50,414.00	2.10
Gray fox	9,217	0.41	16,129.75	0.67
Weasel	17,685	0.78	6,189.75	0.26
Total	2,271,609	100.00	$2,403,660.90	100.00

consideration, the capital value of the Illinois wild fur resource is calculated to be about $35,000,000.

ILLINOIS FUR TRADE

During the 1939-40 fur season, 43 buyers and 5 large fur companies were visited in an effort to determine variations in fur quality, methods of handling and methods of selling Illinois furs. Fig. 32 shows the location of the fur buyers visited. Four of the fur companies are well known St. Louis firms; and the fifth, located in Chicago, does the largest fur business in Illinois. Through the cooperation of both buyers and dealers, considerable information was obtained on various phases of the fur trade in the state.

Quality

Our data are based on general observations, dealers' estimates and many personal inspections of furs. We are not able to give many of the causes for the variation found in quality. This attribute of fur is fundamentally concerned with food, injury, age and season, and could not be studied experimentally in the brief survey made.

Fur quality is ordinarily indicated by several terms, among which "prime," "unprime," "kit" and "damaged" are most common. Color has an important bearing on quality. Furs are usually graded according to a numerical series: "No. 1," "No. 2," "No. 3" and "No. 4," in which size is usually expressed as *extra large, large, medium* and *small.* A *No. 1 extra large* pelt represents the highest grade and value. No. 1 furs are prime and well furred; No. 2's are semiprime; No. 3's are damaged and extremely unprime; and No. 4's are kits, summer pelts and trash.

Illinois muskrats, as characteristic of the species in North America, do not become fully prime until January; hence, a large part of the catch is more or less unprime and is graded as "falls." Muskrats are frequently graded as "falls," "winters" and "springs," the last class being the most valuable. It is significant that on most of the large muskrat marshes under management in Illinois trapping is not permitted until mid December.

Fall trapping for muskrats results in the taking of kits, which are immature animals usually worth only a few cents. Their pelts are graded separately and sold as "linings." Kits made up about 8.5 per cent of the total Illinois muskrat catch in 1939-40. In that year, kits composed about 15 per cent of the opossum catch, 10 per cent of the raccoon catch, 4 per cent of the skunk catch and 2.5 per cent of the mink catch. Weasels, minks and skunks graded out the highest per cent of No. 1's, followed in order by raccoons, gray foxes, muskrats, red foxes and opossums.

According to dealers and fur buyers, in the years of the survey about 11 per cent of all Illinois furs were damaged. Of this volume, an undeterminable small percentage was trash. The per cent of dam-

aged furs amounted to 7, 13 and 14 per cent for the northern, central and southern zones, respectively. Damage was probably most often caused by dogs, and was common among pelts taken by night hunters. The percentage of damaged furs showed a correlation by zones with the amount of night hunting. Other causes of damage were carelessness in skinning and stretching, wherein pelts were cut or torn; fighting by the animals before or after they were taken in traps; and spoilage. Damage from fighting, which in some species shortly precedes mating activity, was common late in the season. Minor types of damage, from the standpoint of volume, were "curling," "singeing," "rubbing" and "fading," all usually a result of wear or mechanical injury and not apparent until late in the season. Muskrats showed by far the largest volume of damaged fur. Opossums showed the highest percentage. This was due probably to the large volume of opossum furs taken with dogs and to carelessness in skinning and stretching these low-priced pelts. Other species such as raccoons and red foxes were occasionally damaged at the time of capture or in handling. A large part of damage in all species is preventable.

Fig. 32.—Location of major fur companies and local fur buyers interviewed in determining quality of Illinois furs and practices employed in the state's fur trade. One major company in Chicago and four in St. Louis, Mo., are represented.

In Illinois minks, an inferior grade known as "cotton" is found. "Cotton" minks are usually detected by blowing into the fur side of the pelt, which discloses the grayish color of the under fur; some skins are so white that the defect is discernible from a distance. There appeared to be a distinct increase in the per cent of "cotton" minks for 1939-40 over the preceding season. Dealers reported that in the northern zone 3.9 per cent, in the central zone 4 per cent and in the southern zone 0.3 per cent of the pelts were of "cotton" quality. The greatest number was reported from the central Illinois River valley, particularly from the vicinity of Havana. Here, one dealer stated that "cotton" minks made up 20 per cent of the catch, but this estimate may be too high. A large fur company, which receives a great deal of Illinois fur, reported that of this state's mink catch 1.46 per cent in 1938-39 and 5.5 per cent in 1939-40 were "cotton" skins. The cause of the defect and the reasons for its increase in 1939-40 are not known. Reduction in value varies with the amount of white, but averages about 50 per cent.

Illinois skunks, which prime early, grade largely to No. 1's and No. 2's; they are further classified according to the length and width of the two white dorsal stripes. These classifications are given in table 21. Pelts containing the smallest amount of white are the most valuable.

As shown in table 21, the highest percentage of dark skunks in Illinois came from the southern zone, although by far the largest skunk catches were made in the northwestern regions of the state. The northern zone produced the highest percentage of broad and narrow stripe pelts.

Mange was observed on red fox, raccoon, opossum and skunk pelts. It probably occurred on others. The infestation

for all species ran less than 1 per cent. A few trappers reported taking lice-infested minks, which were thinly furred and of poor quality. Some of the mink pelts showed wounds, evidently the result of chewing or scratching irritated spots.

Some account was taken of unusual skins observed in various fur-receiving and storage rooms, or reported by dealers. Such pelts usually bring less than furs of normal color, but it should be remembered that they make up an exceedingly small part of the total catch. This information may be presented as follows:

Muskrat—albino, and a dappled color.

Opossum—albino, white (not albino), black and rufus.

Raccoon — albino, cinnamon-albino, black, and yellowish.

Skunk—albino, russet, and broad stripe extending around under tail with white spots on abdomen.

Mink—albino, sorrel, and "cotton."

Coyote—one odd pelt evidently resulting from coyote-dog cross.

Table 21.—Percentages of raw skunk furs of five different qualities, judged on the basis of color alone, from the three Illinois trapping zones, 1938-39 and 1939-40. Figures furnished by fur dealers.

Zone	Black	Star	Short Stripe	Narrow Stripe	Broad Stripe
Northern	4	3	22	39	32
Central	3	7	35	32	23
Southern	9	14	29	25	23

Handling

Despite the more or less standardized system of grading furs according to size and quality, there is a surprising laxity among trappers in handling skins, which has very important effects on quality. Carelessness, most often characteristic of boy and nonprofessional fur-takers, is due to several reasons: lack of individual skill; rush of work, particularly during the early part of the season; and ignorance or shiftlessness. Professional trappers take pride in handling their catches and some of them possess great skill in skinning and stretching, fig. 33. Many trappers are able to skin a muskrat properly in 45 seconds and to stretch it in less time. Some experienced trappers regularly skin muskrats at the rapid rate of 60 per hour.

In Illinois, most trappers visit their traps daily, usually as early in the morning as possible. Unlike north-woods trappers, few have lines so long as to require more than a half day to cover them. Lines run early in the day result in fewer escapes, less damaged fur, less theft and, of course, much less suffering on the part of captured animals. Furbearers still alive are killed by the trapper, usually by drowning if convenient, but often with a hatchet, club or small rifle. Most skunks are shot and most opossums are dispatched by breaking the neck with a stick or hatchet handle placed across it. Mud-coated animals are washed, either in a pond or creek or under a faucet. Skinning, except by the most successful muskrat trappers along the Illinois River, is seldom done in the field. Skinning and stretching are thus usually reserved as afternoon or evening work.

All Illinois furs except raccoon are "cased," that is, not split down the belly. Stretching cased skins is by means of boards or metal frames of such sizes and shapes as to fit the various sizes of skins. Muskrat pelts may be stretched on wire frames, purchased for a few cents each, or on shingles, willow boughs or other devices. Wooden forms are usually employed for the larger species such as foxes. Raccoons, except the better quality northern skins, which grade as "collar" coons, are usually stretched open, and a very large percentage are nailed on barn doors or comparable stretching surfaces. The removal of excess flesh and fat from freshly skinned pelts is necessary to prevent spoilage and "grease burning." The survey disclosed that many trappers were careless in this phase of pelt care. The resultant loss probably amounted to 10 per cent of the value of the annual catch.

Drying or curing is highly important in preparing raw furs for the market. A cool, airy, dry room or attic is the best type of drying place. Muskrats require only two or three days to dry sufficiently for shipping; foxes may require a week or more. Raw furs should never be dried in the sun, before a fire or stove, or treated with salt or other curing preparations.

Trappers operating on a large scale sometimes market their catch unskinned. This is convenient and allows more time for trapping. The catch of the average trapper in Illinois, however, does not warrant such practice. Prompt skinning is necessary since animals left to freeze and thaw quickly deteriorate, thereby greatly reducing fur quality.

Too much emphasis cannot be placed on the need for proper handling of furs. Dealers and large fur companies have emphasized the need for care in skinning, stretching and fleshing, and have promoted such care by awarding daily and weekly cash prizes for the best handled pelts of all important species. Most large companies provide detailed handling instructions, free for the asking.

Very little use is now made of the skinned carcasses of fur animals, although efforts are being made to develop markets for Illinois muskrat meat. Such development would provide annually about 1,000,000 pounds of food now almost entirely wasted. Fox farmers in northern Illinois find limited use for skinned animals in the preparation of feed. There is a slight demand, especially in southern Illinois, for opossum and raccoon meat at low prices. Most of the carcasses are fed

Fig. 33.—An early season catch of well-handled muskrat skins from Vermilion County. The freshly skinned pelts have been stretched and are being dried on wire frames.

to hogs or are buried or burned. Large fur companies usually save the fatty residues from pelts in fleshing operations.

Selling

During the seasons of the survey, approximately 40 per cent of the annual Illinois fur catch was shipped directly to large fur houses, 50 per cent taken to local dealers and 10 per cent picked up at trappers' camps or residences by traveling buyers or representatives of local dealers. Most local dealers finally disposed of their collections to the larger auction houses. On the basis of the best estimates available, about 75 per cent of the total Illinois catch ultimately went to St. Louis and Chicago and the remainder to eastern fur centers.

After the opening date of the Illinois fur season there is a rapid turnover of the catch, beginning with the trapper who disposes of his skins to traveling buyers, local dealers, or the large fur houses, and terminating when the furs have been graded and sorted into large uniform lots for auction to manufacturers. Auctions are usually held on the floors of the large fur companies.

Some local dealers prefer to handle freshly skinned but unstretched pelts, or even unskinned animals, brought in daily by trappers and hunters or collected daily by traveling representatives of the dealers. Dealers buying unskinned animals employ one or more skinners to handle the pelts. This practice results in greater uniformity in handling and somewhat better sales prices. Of the 43 local dealers contacted, 28 preferred to buy stretched and dried pelts, 11 preferred freshly skinned but unstretched pelts, 2 preferred to do their own skinning and 2 had no preference.

No special attempt will be made here to discuss the illegal phases of fur-taking and marketing. The chief evil appears to be before- and after-season trapping. Preseason furs are held until after the season opens, and, other than being more unprime than legal furs, they can scarcely be detected when sold. That early trapping is common was clearly determined during the survey, and it appeared to be especially prevalent in certain parts of southern Illinois. It was apparent that some local buyers encouraged the practice and in this manner attempted to corner the local trade.

Some furs taken after the season closes, in the 10-day postseason interval during which furs may be legally held, are harder to dispose of than preseason furs. A common practice seems to be to carry them into a bordering state having a later season, where they are sold as local furs. The large fur companies in St. Louis and Chicago earnestly encourage legal trapping, but have no practical means of determining the legality of furs purchased either by shipment or in over-the-counter transactions.

SUMMARY

1. The Illinois wild fur resource was studied intensively in the field from June 1, 1939, to June 30, 1940. This paper, prepared subsequently, is the final project report.

2. In the previous literature on Illinois fur animals, which deals mainly with their habits and predator relationships, estimates of the value of the fur resource, prior to about 1930, were lower than the actual value is believed to have been.

3. The main objective of the survey was the determination of facts on which to base biologically sound trapping laws and other regulations pertaining to Illinois fur animals. Such facts involved the habitat requirements of the fur animals, the annual yield and income by species and localities, the portion of furs taken by trappers and by hunters, the number of licensed and unlicensed fur-takers, methods of trapping, hunting and marketing furs, and fur animal cycles.

4. For convenience in sampling, Illinois was divided into eight survey regions, division being on the basis of soil, forest cover, drainage, topography and similar features. Representative sample counties were selected in each region, and survey strips one mile wide were run in an east-west direction at uniform intervals across each. Approximately 11 per cent or more of each sample county was included in the strips. In the eight regions the sample varied from 0.67 per cent to over 9 per cent of the total area. For the state it amounted to 1.7 per cent of the total area. Each household on the sample strips was visited, and information pertaining to fur-

taking on the part of all residents was uniformly recorded. Return trips and much night and week-end work were necessary in order to obtain all records.

5. In 1938-39, the calculated number of Illinois fur-takers, defined as individuals taking furs by their own efforts, was 29,431; in 1939-40, the total was 27,021. About 9,500 individuals each year took furs by hunting; all other fur-takers were trappers.

6. Fur-taker density in the eight regions varied from 0.33 to 0.83 per square mile, the greatest density being in the Glacial Lakes Region north and west of Chicago. The lowest density was in the west-central part of the state, between the Illinois River and the Black Prairie. For the state as a whole, density was about one fur-taker per 2 square miles.

7. Illinois trapping laws in 1938-39 were staggered both by zones and species; in 1939-40, they were staggered only by zones. The basic season was from Nov. 15 to Jan. 15 or 31. In 1938-39, 15,472 licenses were sold; 18,277 were sold in 1939-40. Slightly more than one-half of the Illinois fur-takers in the two seasons were licensed. Unlicensed fur-takers were mainly legal operators on their own or rented land, where they were exempt from the license requirement. The number of fur-takers operating illegally was difficult to determine, but apparently varied by localities from almost none to 10 per cent or more of the total number.

8. Average raw fur prices for the two seasons, determined by averaging amounts received for a large series of pelts of each species from each zone, were low.

9. A summary of the catch, value, population fluctuation, popularity and other pertinent data relating to Illinois fur animals for 1938-39 and 1939-40 is given in table 22.

10. Badgers and coyotes occurred in such small numbers that the sampling methods used did not give reliable data. Otters, beavers and badgers were accorded full protection. Beavers, reintroduced in southern Illinois in 1935, were found to be increasing in numbers. Otters and bobcats occurred in very low numbers, if at all. House cat numbers were estimated at 1,500,000, at least one-half of which were free to hunt out of doors the year around. This species, perhaps the most common predator in the state, was of practically no value in the fur trade.

11. Individual animals of any of the Illinois fur species may be more injurious than beneficial to man, but no species could be classed as wholly destructive. Foxes and weasels, under conditions present at the time of the survey, were probably the most destructive fur animal species in the state. Control of destructive individuals, if necessary involving killing at any time of year, is advocated but, when possible, trapping and hunting in season are recommended as control methods. Usually the services of experienced trappers can be enlisted.

12. Habitats for most Illinois fur animals appeared to be deteriorating more or less steadily at the time of the survey. The most noticeable example was the raccoon habitat, which was being subjected to heavy lumbering. Drainage of lowlands was reducing the area of muskrat and mink range, but the use made of ditches by these two species partly compensated for this loss. Minks had been sharply reduced in numbers during the preceding decade because of the continued high prices of the fur. Opossums and foxes seemed well adapted to conditions existing at the time of the survey, and their numbers, due partly to low fur prices, were stationary or were increasing.

13. Methods of taking furs varied by species and regions. More than three-fourths of the annual fur take was by trappers; the remainder by hunters, operating day or night, with or without dogs. Night hunting was commonest in forested regions, because raccoons and opossums, the two species taken most by night hunters, were most abundant in this habitat. Farm-boy trapping showed a material decline in Illinois; a large part of the fur catch was by experienced trappers who averaged 33 years old. The volume of the catch was found to be greatly influenced by weather, fur prices and industrial conditions.

14. The average annual value of the Illinois fur resource in 1938-39 and 1939-40, summarized in tables 15 to 20, inclusive, was over $1,200,000, which represents a capital value of over $30,000,000 at 4 per cent interest. The fur income for the two seasons reported on was un-

Table 22.—Summary of calculated Illinois fur animal catch, value, trapping and hunting success, population fluctuation and popularity, 1938-39 and 1939-40.

Species	Season	Calculated Total Catch	Average Catch per Square Mile	Calculated Total Income	Average Income per Square Mile	Per Cent of Trappers Taking Species	Per Cent of Hunters Taking Species	Per Cent Taken by: Trappers	Per Cent Taken by: Hunters	Number of Fur-Takers Reporting Fluctuations: Increase	No change	Decrease	Number of Fur-Takers Desiring: More	Fewer
Muskrat	1938–39	884,395	15.61	$707,456.00	$12.48	84	0	100	0	73	63	173	312	7
	1939–40	664,831	11.73	664,831.00	11.73	84	0	100	0	78	49	207	326	2
Opossum	1938–39	244,242	4.31	48,848.40	0.86	57	78	38	62	211	46	26	234	44
	1939–40	171,590	3.03	34,318.00	0.61	53	85	32	68	199	68	41	316	43
Mink	1938–39	53,723	0.95	376,061.00	6.64	52	24	87	13	55	64	112	334	4
	1939–40	42,254	0.80	271,524.00	4.79	57	23	87	13	55	64	156	376	4
Skunk	1938–39	49,640	0.88	37,230.00	0.66	43	28	78	22	88	63	72	256	20
	1939–40	36,681	0.65	36,681.00	0.65	43	34	75	25	108	55	112	313	15
Raccoon	1938–39	42,412	0.75	84,824.00	1.50	23	61	40	60	38	41	179	356	1
	1939–40	34,577	0.61	69,154.00	1.22	26	61	38	62	58	58	183	387	1
Weasel	1938–39	8,889	0.16	3,111.15	0.05	12	0	100	0	28	28	8	36	17
	1939–40	8,796	0.15	3,078.60	0.05	14	0	100	0	33	27	4	63	8
Red fox	1938–39	10,674	0.19	32,022.00	0.57	8	14	49	51	70	8	6	107	44
	1939–40	6,688	0.12	18,392.00	0.32	7	13	53	47	49	15	17	132	34
Gray fox	1938–39	4,328	0.08	7,574.00	0.13	13	3	92	8	32	2	7	48	29
	1939–40	4,889	0.09	8,555.75	0.15	6	3	86	14	28	7	4	44	21

doubtedly below average, because of low raw fur prices.

15. Fur quality, fundamentally influenced by food, injury, age and season, was studied in some detail during the survey, which revealed that about 11 per cent of Illinois furs were damaged, mainly by dogs and improper handling. Kits, of little value in the fur trade, constituted, for muskrat, 8.5 per cent; opossum, 15 per cent; raccoon, 10 per cent; skunk, 4 per cent; and mink, 2.5 per cent. The species showing the highest percentage of No. 1 furs were, in descending order, weasel, mink, skunk, raccoon, gray fox, muskrat, red fox and opossum. Foxes were damaged mainly by dogs, and opossums by both dogs and carelessness in handling this low-priced fur. From 0.3 to 4.0 per cent of the mink pelts had white or "cotton" underfur, and such pelts, size for size, averaged only about one-half the value of normal-colored pelts. Less than 10 per cent of Illinois skunks graded "black" and "star," the most valuable classifications, while about two-thirds graded "narrow stripe" and "broad stripe," the least valuable classifications. Mange was observed on red fox, raccoon, opossum and skunk pelts, and lice infestations were reported in those of mink, but in all cases much less than 1 per cent of the skins or animals were involved.

16. Skill in skinning and stretching pelts was directly proportional to trappers' experience. The best handled pelts came from professional and the poorest handled from inexperienced and boy trappers. The loss due to poor handling is unknown, but probably amounted to at least 10 per cent of the total annual fur income. No adequate market has been developed for fur-animal meat or other by-products.

17. About 40 per cent of the annual fur catch was shipped directly to large fur houses, 50 per cent was sold to local dealers and 10 per cent was picked up at trappers' residences by traveling buyers. The ultimate selling destination of Illinois furs was St. Louis, Chicago and eastern fur centers. Of 43 dealers interviewed, about 65 per cent preferred to buy dried pelts, 25 per cent freshly skinned but unstretched pelts and the remainder preferred unskinned animals or had no preference. Raw furs were found to be always readily salable. It was found that pelts taken illegally, whether before or after the open season, were usually disposed of; those taken before the season by being held until after the season opened, and those taken after the season by being sold in Illinois before the end of the 10-day period during which raw furs might be legally held, or by being transported to and sold in a neighboring state having a season with a later closing date.

18. The average annual income of over $1,200,000 yielded by the fur resource in Illinois was found to be derived practically without management and with no investment except time for harvesting the crop and the small cost of trappers' and hunters' supplies. Practical management measures, correlated with agricultural and other land use, would undoubtedly result in a material increase in the annual income.

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Illinois Furbearer
Distribution and Income

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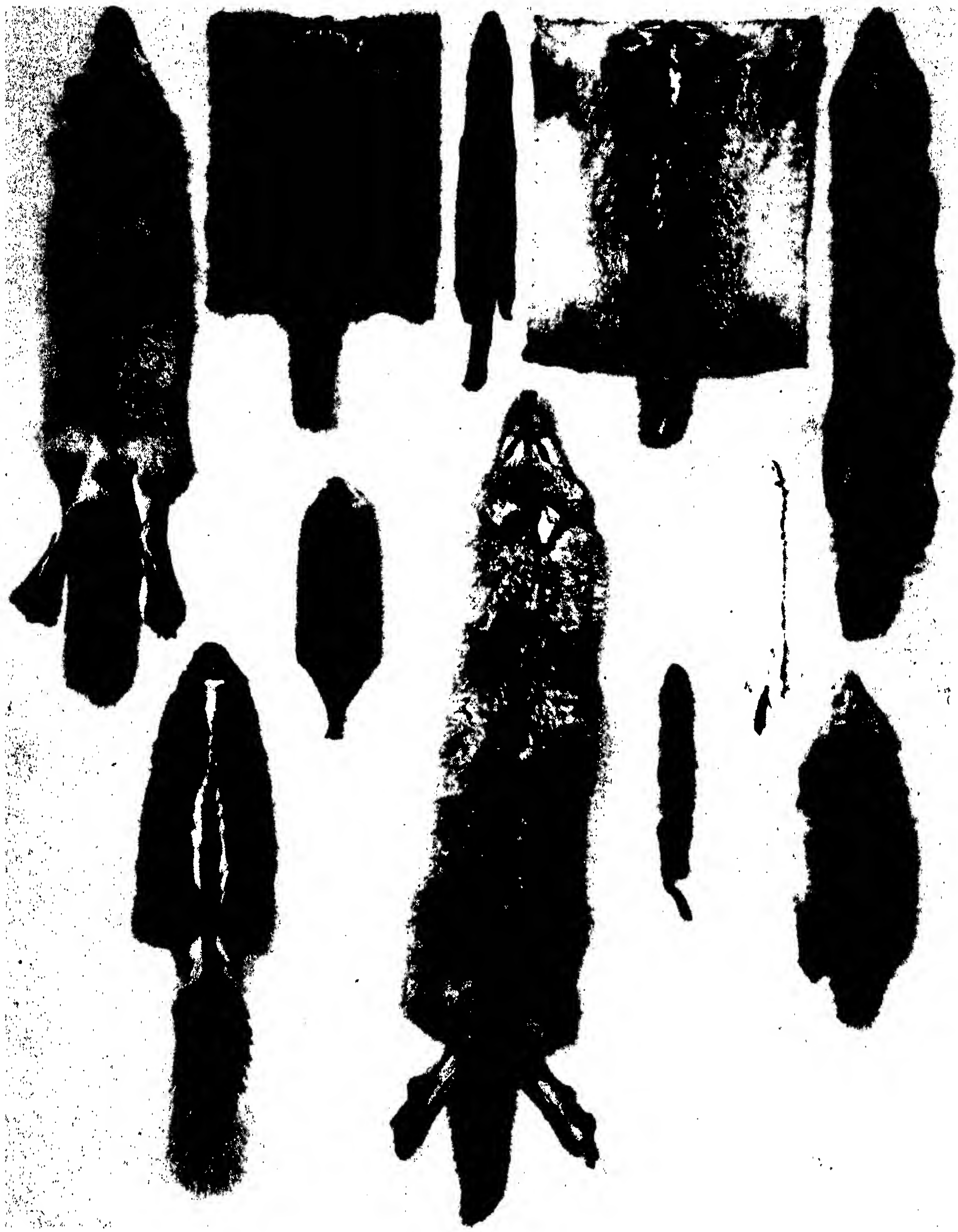


Representative pelts of Illinois fur animals. Left to right, *top row*, red fox, raccoon, mink, badger and gray fox; *lower row*, skunk, muskrat, coyote, long-tailed weasel (brown phase), long-tailed weasel (white phase), opossum. The muskrat ranks first, both in number of pelts and in total value in the Illinois catch; second in number is the opossum, but second in total value of catch is the mink. Third in total value is the raccoon. The most valuable pelt produced by Illinois fur-bearing animals is that of the mink. The skunk pelt shown is the narrow stripe grade. Because of its scarcity, the badger is now protected the year around in Illinois.

Illinois Furbearer

Distribution and Income

CARL O. MOHR

FOR more than a century after Illinois became a state, stock-taking of its renewable natural resources was conducted only irregularly and, in some instances, was not attempted until after serious shortages had become apparent. Those components which, like furbearers, provided but a comparatively small part of an immense state income received scant and casual attention. Within the past few years, however, efforts to evaluate all components have become serious, and these efforts have gained strength as the true value of the resources has become apparent.

About 30 years ago, Dr. Stephen A. Forbes (1912), former Chief of the Illinois Natural History Survey, quoted United States census figures for 1910, stating that the annual yield of mink pelts in Illinois was valued at $6,000 and the yield of muskrat pelts at $14,000. He did not quote income from the other furbearer species. No data regarding the total annual furbearer catch appeared to be available.

Neither technical nor popular interest was great enough to focus further attention of the state's research agencies on furbearers until, in 1930, David H. Thompson, E. C. Driver and D. I. Rasmussen of the Illinois Natural History Survey staff borrowed trappers' reports, fig. 1, from the Illinois State Department of Conservation, to which law provided that each licensed trapper report his catch monthly during the trapping season. These reports, stating the monthly catch of a limited number of trappers for the 1929-30 and 1930-31 seasons, were summarized by the Survey in cooperation with the Department of Conservation; data on these reports are in an unpublished manuscript by Driver (1930) and in unpublished notes by Rasmussen (1931).

The estimated income from important furbearer species was included by Dr. T. H. Frison, Chief of the Illinois Natural History Survey, in several administrative reports (Frison 1931, 1933), most detailed of which was in the *Blue Book of the State of Illinois, 1931-1932*. In this report, Dr. Frison (1931) stated that for the 1929-30 season the total income of licensed Illinois trappers from the seven most important furbearers was estimated at $957,651; almost half of this amount from the sale of muskrat pelts and almost a third from the sale of mink pelts. After allowing for the sale of pelts by fur-takers not required to purchase trappers' licenses, he estimated that "the actual value of the fur yield in Illinois—not including fur farming—must approach at least two millions of dollars." A few years later, Dr. Frison (1938) stated that data at hand indicated an income from the state's furbearers "of one million to two million dollars a year."

A lapse of 3 years followed the studies by Thompson, Driver and Rasmussen, after which the writer prepared data on the state's furbearers for the Natural History Survey's files, using as his source fur-takers' reports made monthly during the trapping season to the State Department of Conservation, from which the writer borrowed them. Later, the writer (1937, 1939, 1941), using the same source of information, reported on the distribution of muskrats, coons and possums in Illinois, and on fluctuations in the state's furbearer catch. Also, the Department of Conservation abstracted the fur-takers' reports for certain years; this agency's figures were mimeographed and distributed by the U. S. Bureau of Biological Survey (1939) and its successor, the U. S. Fish and Wildlife Service (1940) in wildlife leaflets.

According to these leaflets, the total annual catch of fur species in Illinois varied from 238,311 animals in the 1934-35 season to 996,998 in the 1938-39 season. As will be seen later, most of the figures were extremely conservative because up to the season of 1938-39 they failed to take into account the great and unknown numbers of unlicensed trappers. Beginning with the 1938-39 season, figures were revised upward because of preliminary findings of the oral survey, detailed results of which are summarized in the Brown & Yeager report.*

Serious difficulties lay in the way of attaining fully satisfactory total-kill figures from fur-takers' monthly reports made previous to the 1938-39 season. No reliable data on the number of trappers and fur-hunters who operated without licenses, nor on the size of their catch, were available until after adoption of the so-called Pittman-Robertson program in Illinois. As explained in the Brown & Yeager report, Louis G. Brown, leader of a Federal Aid furbearer survey, interviewed trappers, fur-hunters and fur-buyers in 10 counties typical of various regions in Illinois (fig. 2 of Brown & Yeager report) and obtained figures for an estimate of yield in the seasons of 1938-39 and 1939-40. Brown also gathered supplementary data which permitted re-evaluation of yield data derived in the past by the writer from fur-takers' reports made monthly during the trapping season, but he could not obtain more than general impressions from fur-takers about the trend of furbearer catch or populations. In general, fur-takers believed that most species had declined in numbers.

Neither could Brown find time to discover much about the distribution of the less valuable fur-producing species nor about special concentrations of any of the fur-producing species. It goes without much discussion that the distribution of the different species is far from uniform in the sample areas defined and used, each species having a distribution pattern different from that of each of the others. The various distribution patterns cut across the sample areas in every conceivable order, as shown by the oral survey and, in greater detail, by data from fur-takers' monthly reports. (Compare fig. 2 in Brown & Yeager report with the distribution maps in the following pages.)

Distributional information and annual catch data derived from fur-takers' monthly reports are at hand for most of the trapping seasons beginning with 1929-30 and ending with 1939-40 and are here recorded, along with records of the number of licensed fur-takers and estimates of their catch. After being compared with findings of the oral survey, raw data derived from the fur-takers' monthly reports were revised in such a way as to show better than heretofore how the value of the fur catch has stood from year to year. Data for the seasons of 1931-32, 1932-33 and 1933-34 were not available to the writer, and these seasons therefore could not be considered in this study.

*In the present paper, the terms *oral survey* or *Brown's survey* are used to designate the furbearer survey made by Louis G. Brown, results of which are contained in the report often referred to here as the *Brown & Yeager report*, published with this paper as Article 6.

ACKNOWLEDGMENTS

The writer is indebted to the Hon. Livingston E. Osborne, present Director of the Illinois State Department of Conservation, and to Mr. Thomas J. Lynch and the late Mr. C. F. Thompson, former directors, for loan of fur-takers' monthly and annual reports, as well as to Mr. Lewis E. Martin and Mr. J. V. Maloney, formerly of that Department.

Students working under the Federal Emergency Relief Administration and the National Youth Administration assembled most of the data in these reports. Mr. Roy G. Wiesbrock, commerce student at the University of Illinois, aided greatly in final analysis of these figures in 1942 as they were being prepared for publication. During previous years, other University of Illinois students, Mr. Walter J. Godelausky and Mr. Howard C. Shepherd, had assembled and calculated many of the returns.

Many members of the Natural History Survey's Aquatic Biology and Wildlife sections furnished aid and advice. Dr. David H. Thompson, who directed analysis of the 1929-30 and 1930-31 data, Dr. Lee E. Yeager, Dr. R. E. Yeatter and Mr. Louis G. Brown were most closely consulted in strictly technical matters relating to this report.

The photograph used as a frontispiece

was furnished by Sears, Roebuck and Company, Chicago.

NUMBERS OF FUR-TAKERS

In the seasons before 1937-38 covered by this report, the state game code provided that each Illinois fur-taker* operating on land on which he did not reside must buy a trapping license if he took his catch with traps, or a hunting license if he took furbearers by hunting. If the fur-taker operated solely under a hunting license, he was not required to report his catch. If, however, he operated under a trapping license, the law provided that he report all of his catch monthly during November, December, January, February and March on a form, fig. 1, supplied by the State Department of Conservation. If the fur-taker trapped only on farm land on which he resided, he was required neither to buy a license nor to report his catch. Because of numerous loopholes that made law enforcement difficult, the percentage of licensed trappers who reported was low and varied annually, table 1.

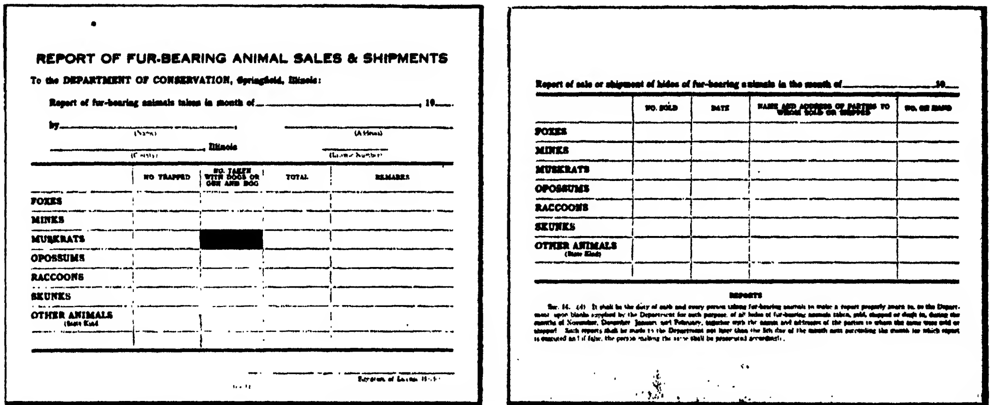
*The term *fur-taker*, as used in this report, usually includes both fur-trappers and fur-hunters.

As will be explained below, the ratio of unlicensed to licensed trappers was probably about 1.5 to 1.0 during the period beginning with the 1929-30 season and lasting through the 1937-38 season, fig. 2 and table 1. After that it decreased because of changes in the game code recorded below and improvement in conservation sentiment.

In the years covered by this report, the number of licensed fur-takers in Illinois has varied from 6,480 to a calculated 16,615, being highest for the 1939-40 season, table 1. The average annual number has been about 11,300, or roughly 110 per county.

Frison (1931), in assuming that the income of the unlicensed fur-takers operating in Illinois during the 1929-30 season was about as great as that of the licensed fur-takers, by implication set the total number of fur-takers at twice the 13,911 reported for the season. A similar procedure in making fur-taker estimates has since been general practice in Illinois, for the sake of being conservative, although the feeling has been common that the ratio of unlicensed to licensed trappers was greater than 1 to 1.

After Brown had made the oral survey


REPORT OF FUR-BEARING ANIMAL SALES & SHIPMENTS

To the DEPARTMENT OF CONSERVATION, Springfield, Illinois:

Report of fur-bearing animals taken in month of ________, 19__

by ________ (Name) ________ (Address)

________ (County), Illinois ________ (License Number)

	NO. TRAPPED	NO. TAKEN WITH DOGS OR GUN AND DOG	TOTAL	REMARKS
FOXES				
MINKS				
MUSKRATS				
OPOSSUMS				
RACCOONS				
SKUNKS				
OTHER ANIMALS (State Kind)				

Report of sale or shipment of hides of fur-bearing animals in the month of ________, 19__

	NO. SOLD	DATE	NAME AND ADDRESS OF PARTIES TO WHOM SOLD OR SHIPPED	NO. ON HAND
FOXES				
MINKS				
MUSKRATS				
OPOSSUMS				
RACCOONS				
SKUNKS				
OTHER ANIMALS (State Kind)				

REPORTS

Fig. 1.—The two sides of the form on which the Illinois game code provided that fur-takers were to make monthly reports of their catch of fur-bearing animals to the State Department of Conservation for the 1938-39 season. Part of the code read as follows: "It shall be the duty of each and every person taking fur-bearing animals to make a report properly sworn to, to the Department, upon blanks supplied by the Department for such purpose, of all hides of fur-bearing animals taken, sold, shipped or dealt in, during the months of November, December, January and February . . . Such reports shall be made to the Department not later than the 5th day of the month next succeeding the month for which report is executed." The code for 1935-36 had read "each and every holder of a trapping license" instead of "each and every person taking fur-bearing animals."

in 10 representative counties in Illinois, he and Yeager calculated that 29,431 fur-takers had operated in the state during the 1938-39 season, table 1; also table 4 of Brown & Yeager report. The number of licenses, as calculated from fur-takers' reports, was 12,810 for the season; about 1.27 times as many fur-takers had operated without as with licenses, exceeding the earlier ratio estimates for previous years by 0.27.

Table 1.—Data on licensed, unlicensed and total fur-takers in Illinois.

Season	Number of Licensed Fur-Takers	Calculated Number of Unlicensed Fur-Takers	Calculated Total Number of Fur-Takers	Per Cent of Licensed Fur-Takers Reporting on Monthly Forms
1929–30	13,911	20,867	34,778	15
1930–31*	11,575	17,363	28,938	10
1934–35	6,654	9,981	16,635	13
1935–36	6,480	9,720	16,200	14
1936–37	9,815	14,723	24,538	11
1937–38	12,560†	18,840	31,400	23
1938–39	12,810†	16,621‡	29,431‡	18
1939–40	16,615†	10,406‡	27,021‡	11
Average	11,303	14,815	26,118	

*Data for the 1931-32, 1932-33 and 1933-34 seasons were not available to the writer.
†These figures were calculated from fur-takers' reports. The average number of licenses per licensed fur-taker was about 1.2, 1.2 and 1.1 in 1937-38, 1938-39 and 1939-40, respectively. Before the 1937-38 season, each fur-taker bought not more than one license.
‡These figures are estimated on the basis of data from the oral survey by Brown.

The oral survey indicated that, during the 1939-40 season, 27,021 fur-takers had operated when, monthly reports seemed to show, 16,615 fur-takers had held licenses. The number of licensed fur-takers exceeded the number of those unlicensed, and the ratio of unlicensed to licensed fur-takers was 0.63 to 1.00.

Six changes in the game code, the first five made in 1937 and the sixth in 1939, so altered trapping conditions as to make the ratios of unlicensed to licensed trappers for the 1938-39 and 1939-40 seasons much too conservative to apply to the seasons preceding them.

The first change, in force by the beginning of the 1937-38 trapping season, provided that each person taking fur-bearing animals, by any method whatsoever, on land on which he did not reside, must purchase a fur-taker's license (Illinois State Department of Conservation 1935, 1937).

The second change provided that each fur-taker, whether or not he held a license, report his catch monthly during November, December, January and February on a form, fig. 1, furnished by the State Department of Conservation.

The third change provided that each applicant for a license, at the time of making his application, report on an annual form, fig. 3, supplied by the State Department of Conservation, the number, or quantity, and species of fur-bearing animals taken by him the next preceding year.

The fourth change provided that each fur-taker trapping on land on which he did not reside must purchase a license for each 25 traps, or fraction of that number, and that each fur-taker operating on the farm land on which he resided must purchase a license for each 25 traps, or fraction of that number, in excess of the first 25 traps to which residence on the land entitled him.

The fifth change provided that each licensed fur-taker identify his traps by means of numbered tags obtained from the State Department of Conservation. This change assisted game wardens in distinguishing legal from illegal trapping and forced the purchase of licenses by some of the trappers who had previously been able to evade the law.

The 1937 code changes were effective in

bringing to record about 2,400 fur-hunters who had previously reported neither themselves as fur-takers nor the amount of their catches. The number of reporting fur-hunters rose from a previous annual high of 15 per cent of the reporting fur-takers (about 1,500 individuals) in 1936-37 to 30 per cent (about 3,900 individuals) in 1937-38.

The sixth change in the code, in force beginning with the 1939-40 season, plugged another loophole by providing that each unlicensed, as well as licensed, trapper must tag all of his traps (Illinois State Department of Conservation 1939). This provision apparently was responsible for much of the numerical difference between the 12,810 fur-takers licensed during the 1938-39 season and the 16,615 licensed during the 1939-40 season, and for the reduction in the ratio of unlicensed to licensed trappers. It brought to record probably about 4,000 trappers who the previous year had not been recorded.

With the six changes in the law mentioned above, the number of licensed trappers increased from 9,815 in 1936-37 to a calculated 16,615 in 1939-40, an increase of 6,800, indicating that if these changes had not been made the ratio of

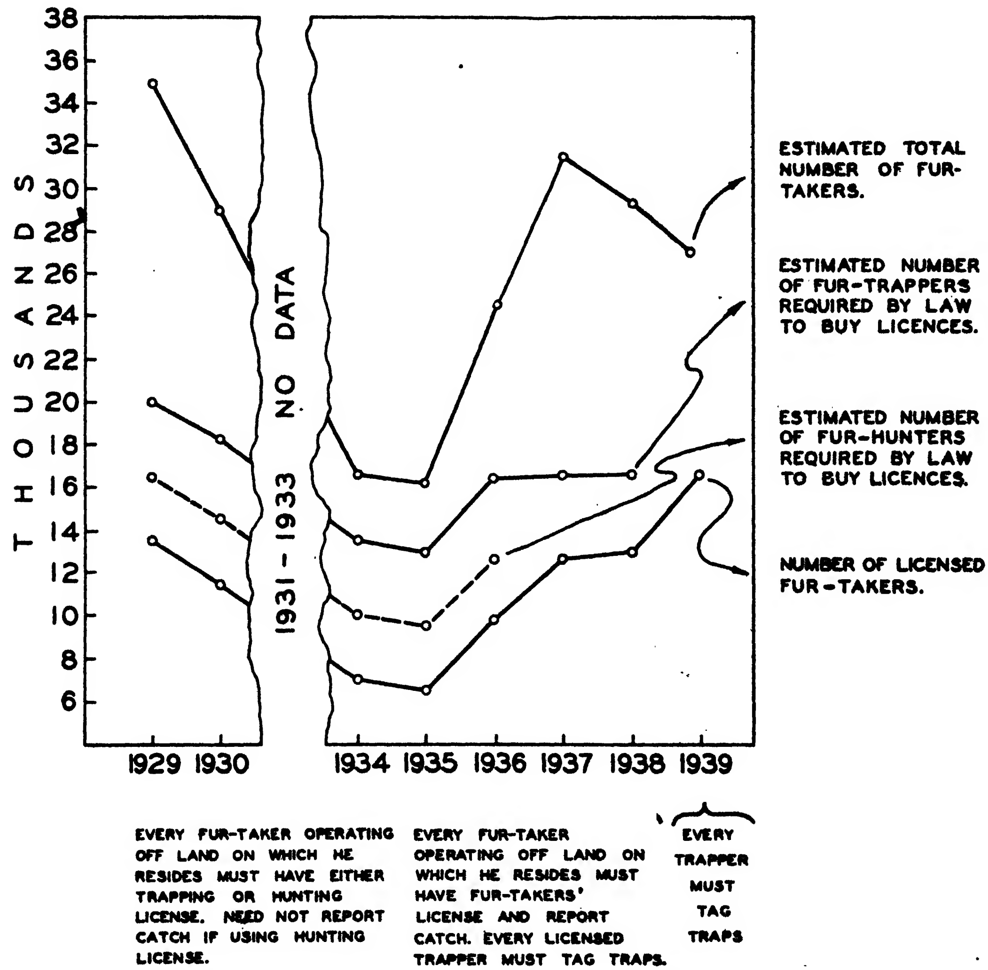
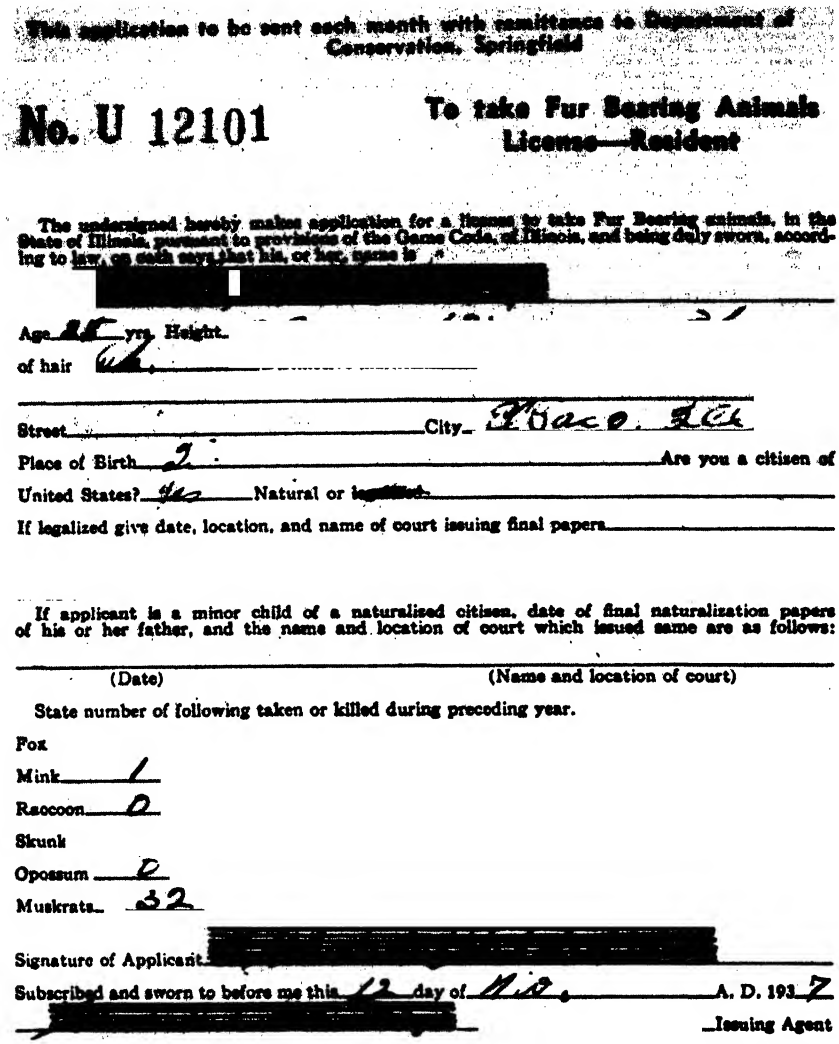


Fig. 2.—Graph showing the number of licensed fur-takers, estimated number of fur-hunters required by law to buy licenses, estimated number of fur-trappers required by law to buy licenses, and estimated total number of fur-takers for eight trapping seasons included in the present study. Each trapping season is indicated by only one date; for instance, the trapping season of 1929-30 is represented by the date 1929. The graph illustrates the effect of changes in the code.

licensed to unlicensed trappers would have been about 1.00 to 1.50 instead of 1.00 to 1.27, as found after the oral survey was begun following the 1937 revision, and 1.00 to only 0.63, as found after the 1939 revision. The estimated numbers of unlicensed fur-takers for years of this study previous to the 1938-39 season are based on the ratio of 1.00 licensed fur-taker to 1.50 unlicensed fur-takers.

By adding the known or calculated number of licensed fur-takers to the calculated number of unlicensed fur-takers in Illinois, in each of the seasons covered by this report, we arrive at close approximations of the total number operating in those seasons, table 1 and fig. 2. Calculations for the 1938-39 and 1939-40 seasons are based in part on data obtained by the oral survey.

Calculations recorded in table 1 indicate that the lowest number of fur-takers operating in Illinois during any one season covered by this report has not been less than 16,200 and that the average annual number has been 26,118. La Due (1935)



This application to be sent each month with remittance to Department of Conservation, Springfield

No. U 12101

To take Fur Bearing Animals License—Resident

The undersigned hereby makes application for a license to take Fur Bearing animals, in the State of Illinois, pursuant to provisions of the Game Code, of Illinois, and being duly sworn, according to law, on oath says that his, or her, name is [redacted]

Age [illegible] yrs. Height

of hair [illegible]

Street ______ City [illegible]

Place of Birth [illegible] Are you a citizen of

United States? [illegible] Natural or legalized

If legalized give date, location, and name of court issuing final papers

If applicant is a minor child of a naturalized citizen, date of final naturalization papers of his or her father, and the name and location of court which issued same are as follows:

(Date) (Name and location of court)

State number of following taken or killed during preceding year.

Fox

Mink 1

Raccoon 0

Skunk

Opossum 0

Muskrats 32

Signature of Applicant [redacted]

Subscribed and sworn to before me this 12 day of [illegible] A. D. 1937

[redacted] Issuing Agent

Fig. 3.—Application for Illinois fur-taker's license for use in the 1937-38 season. The game codes of 1937 and 1939 specified that the applicant state the number of certain fur-bearing animals taken or killed by him the preceding year.

published a map with figures, credited to the National Fur Tax Committee, indicating that the "number of trappers" in Illinois was 132,990, but these numbers were perhaps misquoted and are certainly erroneous. Calculations for the seasons reported here set the average annual number of trappers at about 256 per county, an average of slightly less than 1 to each 2 square miles. The number was exceeded considerably in the season of 1929-30, when the average per county was about 340, and it was exceeded also in the 1930-31, 1937-38, 1938-39 and 1939-40 seasons. The numbers are, of course, greatest in those counties where trapping is most profitable or where such game-fur animals as coons and foxes provide extensive sport.

COMPARISON OF DATA

The Brown & Yeager study was designed in part to obtain a check on the accuracy and usefulness of data based on fur-takers' monthly reports, which were being used for studying (1) trends in the Illinois furbearer catch over a period of years and (2) distribution patterns of furbearers. When the 10 counties were selected as sampling grounds representing widely varying conditions in widely scattered regions in Illinois (fig. 2 of the Brown & Yeager report), it was known that the resulting figures would not coincide with those from the fur-takers' monthly reports, but the probability of similarities was recognized. We wished to find the nature and extent of both similarities and differences.

Trends in Furbearer Catch.—For making annual comparisons between figures from the oral survey and those from the fur-takers' monthly reports, two methods of working up raw data from the monthly reports were attempted. The first method involved, for each important furbearer, a calculation by counties of (1) the percentage of fur-takers who, on the monthly report blanks, reported catching that fur-bearer and (2) the reported average catch per effective fur-taker* of that furbearer; these figures were then weighted according to the relative size of the counties.

The second method, which was finally rejected, involved a calculation for the state as a whole of the percentages and averages mentioned in the first method; no weighting was done.

Weighted data derived from the first method were less subject to local law enforcement irregularities than were data from the second, and they corresponded closely with figures calculated from data accumulated for the Brown & Yeager report.

Data from this first method, such as that contained in table 2 and similar tables, can therefore be used as *index figures* by which changes in effective fur-takers and catch can be measured over a period of years. These figures, hereafter usually referred to as *monthly report index figures*, are believed to be the most useful obtainable to indicate *trends over a period of several years*, because up to the season of 1938-39 it had not been possible to trace by any other means the changes in numbers of fur-takers in the several parts of Illinois.

The monthly report index figures show the greatest deviation from figures derived from the oral survey in the case of muskrats. For the 1938-39 season, the difference was 7 points and during the following season it was 10 points. Figures for most of the other furbearers deviated only 4 points or less. We believe that the deviation is not so great as to invalidate general conclusions about the average annual catch, or fluctuations in the catch from year to year.

Numerical differences between the data derived from the oral survey and those from fur-takers' monthly reports are to be expected. It is probable that the relatively small number of fur-takers represented by the monthly reports, table 1 and fig. 2, is selective and therefore not representative of the whole group. It is plain, too, that weighting the data from the monthly reports by area does not weight them according to the total number of trappers, which would be a better weighting factor if it could be obtained.

The monthly report figures represent several seasons, include trappers in every county in the state, and of necessity take into account only those trappers who ac-

*As used in this report, the term *effective fur-taker* refers to a person who, in the season or seasons under consideration, has caught at least one individual of the furbearing species being discussed. Thus, a fur-taker who in a given year has caught muskrats but no other fur species is regarded in that year as effective for muskrats only.

tually reported. The oral survey data, as explained in the Brown & Yeager report, represent two seasons, cover 1.7 per cent of the area of the state and include within the strips actually surveyed all trappers, licensed and unlicensed, those who reported and those who did not.

Despite numerical differences, correlations between the monthly report index figures and the oral report data, for both average catch per fur-taker and percentage of fur-takers catching a given furbearer, is such as to provide valuable information regarding trends in catch.

The differences between the two sets of data are found to be largely in level, and similarities to consist chiefly of parallelisms. In other words, though differences exist, positive correlations are found in figures from the two studies.

Distribution Patterns of Furbearers.—In general, it is true that the size of the average catch per fur-taker of a given furbearer correlates closely with the size of the population of that furbearer. After calculating for any furbearer species the average catch per fur-taker, we can transfer the resulting data to a map in such a way as to give us a logical and useful graphic representation that is a good clue to combined dispersion and abundance of the animal.

Such a map has been made for each of the common furbearers discussed in this study. These maps are the best clues we have to the distribution pattern of furbearers in all Illinois counties. On these maps, the calculated figures are converted into dots in such a way that the county having the largest average catch in a given species is most heavily dotted, and other counties are dotted proportionately. Each species is considered separately, and the maps do not indicate relative abundance as among species; for instance, although the distribution map for minks is about as heavily stippled as that for muskrats, these maps are not intended to suggest that the catch of minks is as large as that of muskrats. Eight seasons of fur-takers' records are summarized on the maps, the first of which is shown in fig. 4.

These distribution maps indicate to what extent one set of data (from the oral survey showing average catch per square mile for two seasons) parallels or correlates with another set of data (from the fur-takers' monthly reports showing average catch per fur-taker for eight seasons). On these maps, oral report data are shown as numerals; as stated above, fur-takers' written report data are represented by dots. Comparison of the two sets of data reveals a close correlation.

It will be seen that the distribution pattern of no two species is exactly alike and in most cases is not even similar. Each species is a law unto itself in this matter. Its distribution does not conform completely to any easily apparent physical or agricultural characteristic of the land, and management must take into account this lack of conformity.

The scope of this study did not permit construction of separate dispersion and localized abundance maps, which would show facts that the distribution, or combined dispersion-abundance, maps do not portray: whether the furbearer populations are widely dispersed and small, narrowly dispersed and small, widely dispersed and large, or narrowly dispersed and large. From a management point of view, each of these cases is important.

In constructing a dispersion map, we first calculate the percentage of fur-takers who trapped a given species in each county, or other relatively small geographical unit; then we transfer the data to a map by use of dots and find a logical and useful pattern showing what proportion of fur-takers in any given area caught that particular species. Such a map furnishes a good clue to the dispersion of the furbearer. If, in a given area, only a small proportion of the fur-takers caught the species, there is every likelihood that this species was not so widely distributed as in some area in which a large proportion of fur-takers caught it.

In constructing a localized abundance map, we first calculate for any given species of furbearer the average catch per effective fur-taker, transfer these data to a map by use of dots and again find a logical and useful pattern. A map of this kind will be somewhat different from the dispersion map because it will show not the proportion of fur-takers who caught the furbearer but the size of the average catch. Such a map furnishes a useful clue to the abundance of any furbearer in small, localized areas where it is present. If the average catch of a given

furbearer in a given area is large, the population of the furbearer in that area is very likely to be large, and, if small, the population is likely to be small.

MUSKRAT*

Distribution.—Muskrats, fig. 4, are present in every Illinois county and are most numerous in Lake and McHenry counties, north of Chicago, where ponds, marshes and herb-lined lakes and slow, stable streams are at once widespread and excellent habitats. With some exceptions the numbers of muskrats diminish gradually to the west and south until, in the very southernmost counties, where the swamps and the violently fluctuating streams are highly unfavorable, these furbearers are almost rare. A Champaign County muskrat is shown in fig. 5.

Table 2.—Weighted per cent of Illinois fur-takers who reported catching muskrats, and weighted average catch of muskrats per effective fur-taker; data derived from fur-takers' monthly reports, and weighting done on the basis of the relative size of the counties represented in the years for which records are available.

SEASON	WEIGHTED PER CENT OF FUR-TAKERS CATCHING MUSKRATS	WEIGHTED AVERAGE CATCH OF MUSKRATS PER EFFECTIVE FUR-TAKER
1929–30....	81	22
1930–31....	83	25
1934–35....	85	26
1935–36....	91	23
1936–37....	86	24
1937–38....	70	28
1938–39....	73	30
1939–40....	75	31
1940–41....	70	33
1941–42....	63	30

Figures from the oral survey indicate that the catch of muskrats in Lake County was about 26 times as great as that in Union County during the 1938-39 and 1939-40 seasons.

Trappers, Catch and Income.—As shown in table 2, the index figures derived from the monthly reports for per cent of fur-takers catching muskrats increased gradually from 81 in the 1929-30 season to 91 in the 1935-36 season, after which they declined to 63 in the 1941-42 season.

Monthly report index figures for the per cent of fur-takers catching muskrats are 7 and 10 points lower for the 1938-39 and 1939-40 seasons, respectively, than the figures derived from data assembled during the oral survey.

The index figures derived from the

*The scientific names of fur animals mentioned in this paper are listed facing the contents page of the Brown & Yeager report.

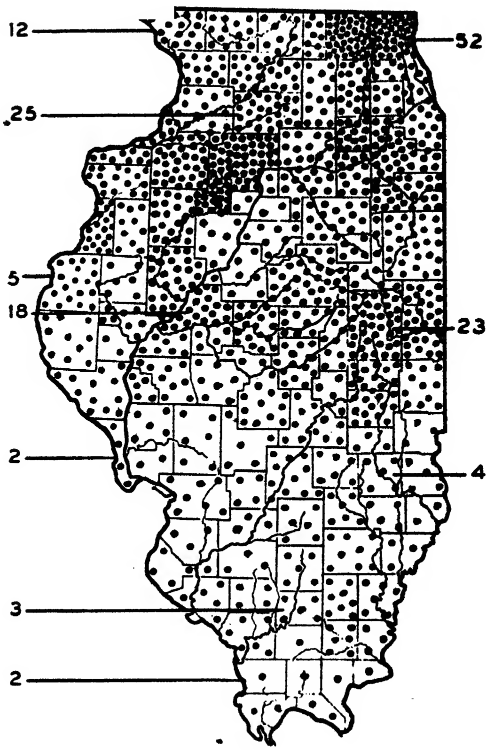


Fig. 4.—Distribution of muskrats in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40. Data from these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

monthly reports for the muskrat catch per effective fur-taker vary from 22 to 33, table 2. For the 1938-39 and 1939-40 seasons, they are respectively 7 and 10 points lower than the figures for catch per effective fur-taker as derived from data collected by Brown; the average difference is about 9 points.

If similar correlations, or differences, between figures derived from the oral survey and the written monthly reports prevailed before the 1938-39 season, we may assume that in the seasons covered by this report, ending with 1939-40, approximately 18,375 fur-takers caught muskrats annually in the state. The annual catch of muskrats is calculated to have been 745,000 during the 1929-30 season and 884,395 and 664,831 during the 1938-39 and 1939-40 seasons, respectively; figures for the last two seasons are from table 6 of the Brown & Yeager report. The average annual catch is estimated at about 653,000 muskrats. Income is estimated to have averaged around $500,000 annually. Averages are for the seasons of this study ending with 1939-40.

These averages indicate about 1 muskrat trapper to 3 square miles, or roughly 180 trappers per county; about 12 muskrats caught per square mile, or approximately 6,400 per county; and $9 worth of muskrats caught per square mile, or about $4,900 worth per county. Figures are, of course, higher than the averages in more favorable regions and lower in the less favorable. These regions are indicated in fig. 4. The average catch per square mile for the 1938-39 and 1939-40 seasons is recorded in table 6 of the Brown & Yeager report.

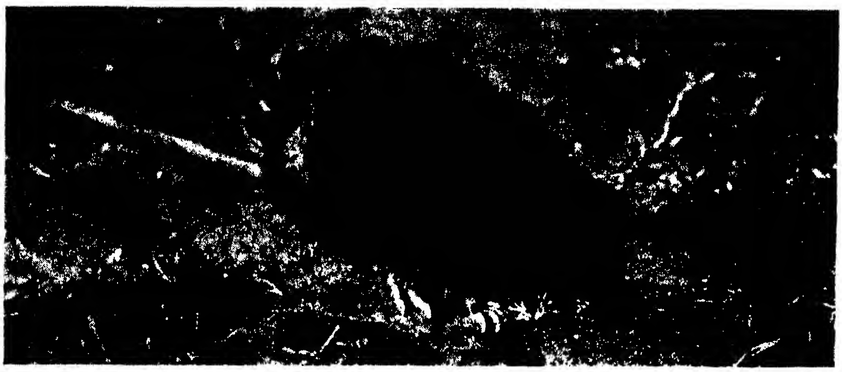


Fig. 5.—Muskrat caught in Champaign County. No furbearer occurs in greater numbers in Illinois than the muskrat. Nor do all of the state's other furbearers combined yield as great an annual cash return.

MINK

Distribution.—The distribution of the mink catch, fig. 6, shows considerable irregularity. Several centers of abundance are apparent, one being in Lake County and another in Schuyler County. Generally, however, minks are moderately abundant in the northeastern quarter and the western half of Illinois. The largest

Table 3.—Weighted per cent of Illinois fur-takers who reported catching minks, and weighted average catch of minks per effective fur-taker; data derived from fur-takers' monthly reports, and weighting done on the basis of the relative size of the counties represented.

Season	Weighted Per Cent of Fur-Takers Catching Minks	Weighted Average Catch of Minks Per Effective Fur-Taker
1929–30	55	3.6
1930–31	62	3.3
1934–35	57	3.1
1935–36	58	3.4
1936–37	65	3.3
1937–38	50	2.9
1938–39	51	3.5
1939–40	51	3.4
1940–41	52	3.5
1941–42	43	2.8

center of relative scarcity lies in the southeastern quarter of the state.

About nine times as many minks were caught in Lake County as in Mason County, in 1938-39 and 1939-40, according to Brown's survey. It is probable that some of the counties in the southeastern quarter of the state had even fewer minks than did Mason County, fig. 6.

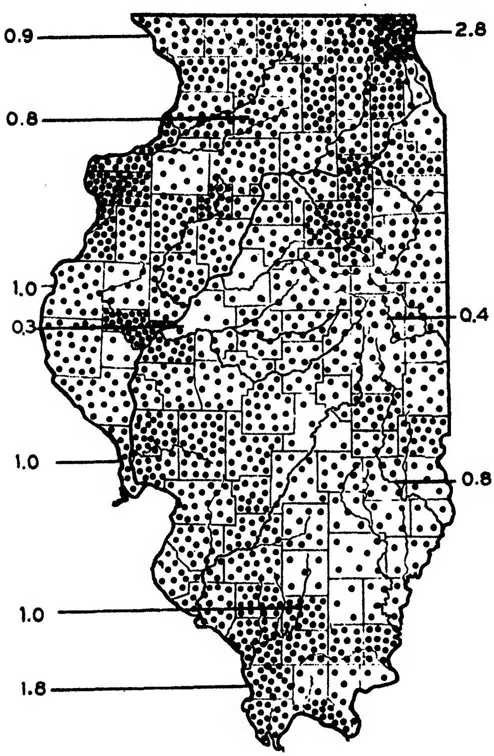


Fig. 6.—Distribution of minks in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40. Data for these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

Trappers, Catch and Income.—The index figures for percentage of fur-takers catching minks, table 3, vary from 65 and 62 during the 1936-37 and 1930-31 seasons, respectively, down to 43 in 1941-42, indicating a general population decline. The index figures are 5 and 6 points higher for the 1938-39 and 1939-40 seasons, respectively, than the percentages calculated on the basis of the oral survey data. Monthly report data show no change for the two seasons in the percentage of fur-takers catching minks, but oral report data indicate a rise in the second season.

The catch-per-effective-trapper index figures show no definite general trend for the 10 years for which we have data; the highest figure is 3.6 and the lowest 2.8, table 3. Index figures are 1.0 and 0.3 point lower for the 1938-39 and 1939-40 seasons, respectively, than the average catch figures derived from data accumulated by the oral survey for these seasons. Monthly report and oral report data indicate a drop for the second season.

If these correlations, or differences, between the oral survey figures and monthly report indices held approximately constant back through 1929-30, then we may assume that about 12,400 fur-takers caught minks annually; the numbers were 15,600 and 17,800 during the 1929-30 and 1930-31 seasons, respectively, and 14,197 calculated for 1939-40 from data obtained and assembled by Brown. Also, we may assume, the total annual catch by these mink hunters and trappers was 72,000 and 87,000 during the 1929-30 and 1930-31 seasons, respectively, and 45,254 for 1939-40, as recorded in table 11 of the Brown & Yeager report, with an annual average of 56,000. Income from minks is assumed to have averaged about $310,000 annually. Averages are for the seasons of this study ending with 1939-40.

The above figures mean an average of about 1 mink trapper to each 4 square miles, or roughly 121 per county; about 1 mink caught per square mile, or roughly 560 per county; $5.50 worth of minks per square mile, or $3,100 per county.

A general decline in mink populations is indicated, the per cent of fur-takers who caught minks, and the number of successful mink trappers as well, having fallen noticeably in 10 years. The fact that the average-catch-per-effective-fur-taker indices show no consistent decrease suggests that the decline is due to actual disappearance of minks over wide areas rather than mere thinning of standing populatio

RACCOON

Distribution.—The distribution of the coon* population, fig. 7, in Illinois is much like that of the possum* population, fig. 10. Coons, fig. 8, are least common in the prairie region centering around Livingston County and in an area in the south central part of the state. They are most common in the wooded counties bordering the Mississippi, Illinois, Ohio and Wabash rivers, particularly in those bordering the Mississippi and the Ohio in the southern end of the state.

Table 4.—Weighted per cent of Illinois fur-takers who reported catching coons, and weighted average catch of coons per effective fur-taker; data derived from fur-takers' monthly reports, and weighting done on the basis of the relative size of counties represented.

Season	Weighted Per Cent of Fur-Takers Catching Coons	Weighted Average Catch of Coons Per Effective Fur-Taker
1929–30....	31	2.8
1930–31....	28	2.7
1934–35....	24	2.6
1935–36....	29	2.3
1936–37....	27	2.4
1937–38....	32	2.8
1938–39....	33	3.0
1939–40....	35	2.8
1940–41....	35	3.2
1941–42....	37	3.0

According to figures from the oral survey, the yield in Calhoun County was 23 times as great, and in Union County it was 14 times as great, as in Champaign County.

Trappers, Catch and Income.—Monthly report data indicate for the period of this study a decline of the coon catch (possibly ending about 1933), followed by a strong recovery, table 4. For the 1938-39 and 1939-40 seasons, index figures for per cent of fur-takers catching coons, table 4, are respectively 2 and 3 points lower than the corresponding figures calculated from information assembled during the course of the oral survey. In both sets of data, the 1939-40 figures show a slight rise over those of the previous season. The average-catch-per-effective-fur-taker indices show a strong recovery after the 1936-37 season; the weighted figures varied from 2.3 during the 1935-36 season up to 3.2 during the 1940-41 season, table 4. In both 1938-39 and 1939-40, they are 0.9 point below the average catch figures for corresponding years revealed by data accumulated for the Brown & Yeager report. Both sets of data, therefore, show a slight decline for

*Both popular and literary usage sanctions use of the word *coon* for *raccoon* and *possum* for *opossum*.

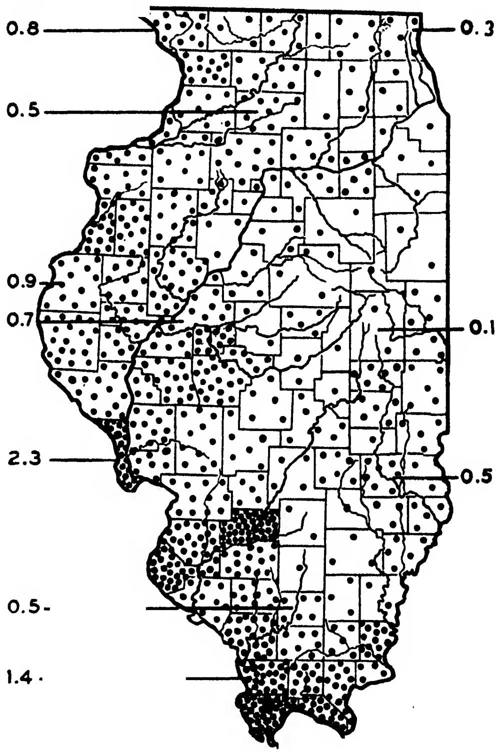


Fig. 7.—Distribution of coons in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40. Data from these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

the 1939-40 season as compared with those of the previous season.

If these correlations, or differences, between monthly report index figures and corresponding figures derived from data accumulated in the course of the oral survey were constant previous to the 1938-39 season, then we may assume that an aver-

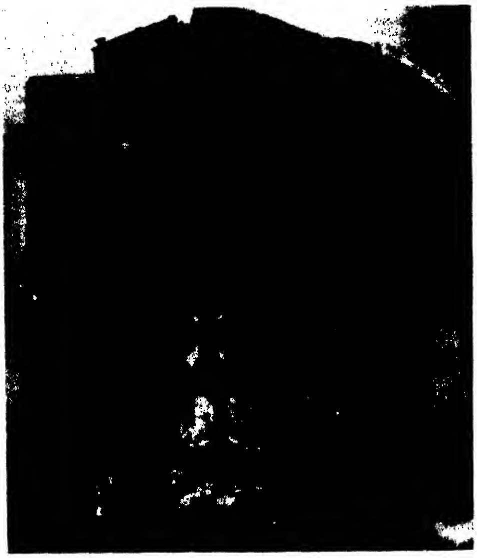


Fig. 8.—Female coon in slab box on the Chautauqua National Wildlife Refuge, Mason County. The box, originally erected for wood ducks, had been appropriated by the coon which, shortly before the picture was taken, had given birth to four young.

age of approximately 8,800 fur-takers caught coons annually; the calculated number was about 12,000 during the 1929-30 season and about 11,210 during the 1939-40 season, 10 years later. As will be noted below, these figures are very conservative. The total annual catch of these coon trappers and hunters is estimated to have averaged at least 32,000. Income is estimated to have averaged about $102,000 annually. Averages are for the seasons of this study ending with 1939-40.

The above figures are equivalent to about 1 coon hunter or trapper per 6.4 square miles, or 86 per county; 1 coon to 1.8 square miles, or 314 per county; about $1.80 per square mile, or $1,000 per county.

It is possible that the number of coon takers in 1929-30 may have been as high as 50,000. It will be noted that, in the 1937-38 season, there was a large and suddenly increased percentage index of coon catchers from 27 to 32, an increase of 5 points, table 4. This 1937-38 figure was greater than that derived for any previous year, even 1929-30, and was due apparently to a change in the law, bringing a suddenly increased number of fur hunters to record, fig. 2. Fur hunters average a greater number of coons per individual than do trappers. Indications are that the 1936-37 data and those for all previous seasons should be raised 5 points to allow for inclusion of hunters not then recorded. Then the percentage of those fur-takers who caught coons in 1929-30 would be up around 36 instead of 31. This situation should be considered when examining the above calculations, which are based on the lower percentages. Probably the total catch of coons declined more than our conservative figures show.

SKUNK

Distribution.—The average catch of skunks per fur-taker, converted into dots in such a way as to show the relative size of the catch in each county, indicates that the greatest skunk populations lie near our largest rivers, fig. 9. The counties along the Illinois River and the southern Illinois counties along the Mississippi stand

Table 5.—Weighted per cent of Illinois fur-takers catching skunks, and weighted average catch of skunks per effective fur-taker; data derived from fur-takers' monthly reports, and weighting done on the basis of the relative size of the counties represented.

Season	Weighted Per Cent of Fur-Takers Catching Skunks	Weighted Average Catch of Skunks Per Effective Fur-Taker
1929–30....	55	5.0
1930–31....	59	5.9
1934–35....	56	5.9
1935–36....	45	4.7
1936–37....	64	5.3
1937–38....	49	3.7
1938–39....	48	3.7
1939–40....	48	3.7
1940–41....	51	3.9
1941-42....	44	3.1

out as yielding most skunks. These are rolling and brushy. An area in the south central part of Illinois, another around

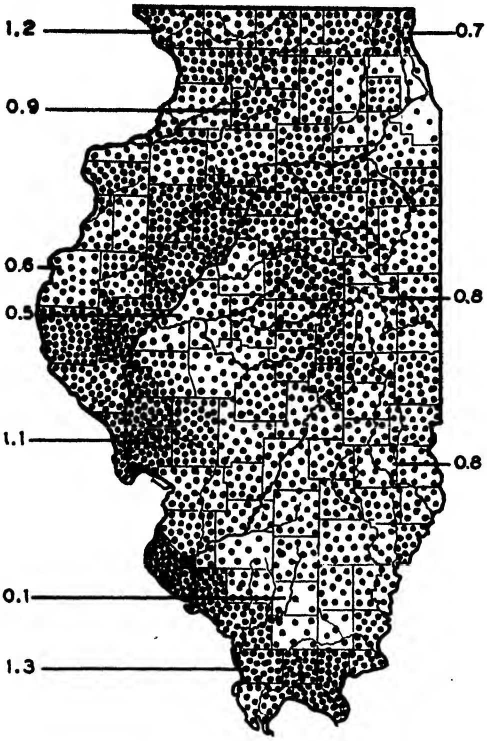


Fig. 9.—Distribution of skunks in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40. Data from these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

Springfield and a third around Cook County show yields of the smallest numbers.

Among those counties that were surveyed by Brown, Franklin shows the smallest yield per square mile, and Union, Jo Daviess and Calhoun counties the largest. The yield in Union County was 13 times as large as the yield in Franklin County.

Trappers, Catch and Income.—Index figures for per cent of fur-takers catching skunks show a general decline, table 5. The index figure is 55 for 1929-30 and 44 for 1941-42, but in intervening years figures as high as 59 and 64 are recorded.

The average catch indices also decline; from 5.9 during the 1934-35 season, the trend is downward, with some irregularities, to 3.1 during the 1941-42 season, table 5.

For 1938-39 and 1939-40, index figures for per cent of fur-takers catching skunks are the same as, to 8 points higher than, corresponding figures calculated from data accumulated during the course of the oral survey. The average-catch-per-effective-fur-taker indices are from 0.1 to 0.5 point higher than the average catch per fur-taker calculated from the oral survey data, the average difference being 0.3.

If the differences and similarities between monthly report index figures and figures calculated from oral survey data obtain for years of this study previous to 1938-39, then we may assume that approximately 13,000 fur-takers caught skunks annually; the number is calculated to have been about 18,000 in 1930-31 and about 12,000 during the 1938-39 season. The average annual catch of skunks was about 58,000, having dropped from about 80,000 in 1929-30 to a calculated 36,681 in 1939-40, but with higher figures in some of the intervening years. The calculated average annual income from skunks was about $70,000. Averages are for the seasons of this study ending with 1939-40.

These averages are equivalent to about 1 skunk hunter or trapper per 4.3 square miles, or roughly 130 per county; somewhat more than 1 skunk per square mile, or roughly 580 per county; about $700.00 per county, or about $1.25 per square mile.

OPOSSUM

Distribution.—In Illinois, possums are most common in the southern part of the state, particularly in those counties lying along the Mississippi and the Ohio rivers, as shown by the density of stippling in fig. 10, which is based on monthly report data for the average bag per fur-taker. They are least common in the prairie region centering on Livingston County.

Fig. 11 shows a possum from northern Illinois.

The oral survey indicates that the average catch per square mile in Calhoun County, one of the best, was 16 times as great as that in Champaign County.

Trappers, Catch and Income.—The index figures for the percentage of fur-takers catching possums show well-marked upward and downward trends that have the appearance of being cyclic, table 6. The figures rise from 54 for the 1929-30 season to 74 for the 1934-35 season, and then decline to 60 for the 1936-37 season, only to rise again to 68 during the 1939-40 season; after that they again decline.

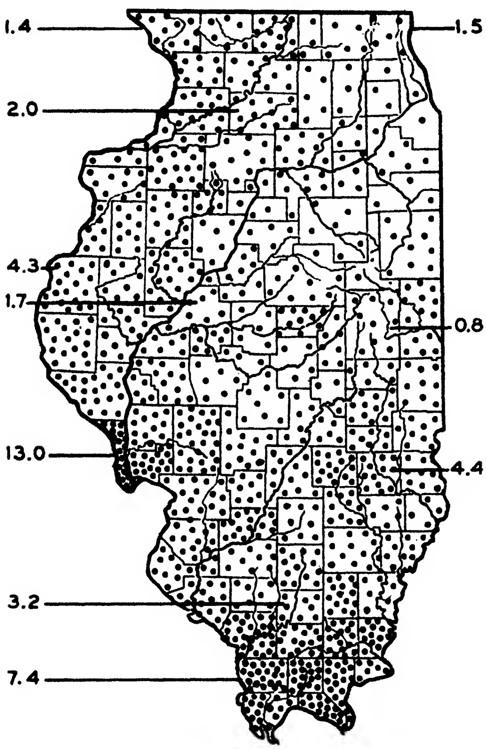


Fig. 10.—Distribution of possums in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31, and 1934-35 through 1939-40. Data from these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

Table 6.—Weighted per cent of Illinois fur-takers catching possums, and weighted average catch of possums per effective fur-taker; data derived from fur-takers' monthly reports, and weighting done on the basis of the relative size of the counties represented.

Season	Weighted Per Cent of Fur-Takers Catching Possums	Weighted Average Catch of Possums Per Effective Fur-Taker
1929–30....	54	5.0
1930–31...	59	4.6
1934–35....	74	6.2
1935–36....	65	5.3
1936–37....	60	4.6
1937–38....	62	6.0
1938–39....	65	8.0
1939–40....	68	8.1
1940–41....	66	6.9
1941–42....	61	6.3

The trend of the weighted figures for average catch of possums per effective fur-taker is similar and is cyclic in appearance, table 6. They are highest for the 1938-39 and 1939-40 seasons.

Because data for the critical period between the 1930-31 and 1934-35 seasons are not available, it is not possible to measure the distances between troughs and peaks in the cycle.

For the seasons of 1938-39 and 1939-40, the monthly report index figures showing per cent of fur-takers who caught possums are respectively 1 and 4 points higher than corresponding data derived from oral survey figures. For these same seasons, figures for the average catch of possums per effective fur-taker are respectively 3 points and 1 point lower than the catch per fur-taker averages calculated from data accumulated during the course of the oral survey.

If the same relationships between oral survey and written monthly report data held during previous years of this study, then we may assume that about 16,000 fur-takers caught possums annually; the number declined from about 20,000 during the 1929-30 season to 10,000 during the 1935-36 season and then rose to about

18,000 during the 1938-39 and 1939-40 seasons. These fur-takers are estimated to have averaged about 141,000 possums annually; most during the 1938-39 season, when the figure was about 244,000. The estimated annual income averaged about $39,000. Averages are for the seasons of this study ending with 1939-40.

The above figures indicate about 1 possum hunter or trapper to 3.5 square miles, or roughly 160 per county; about 2.5 possums per square mile, or 1,400 per county; an income of about 70 cents per square mile, or roughly $390 per county.

Fig. 11.—An immature possum caught in Cook County, 1941.

FOXES

Distribution.—The catch of foxes in Illinois, fig. 12, estimated from fur-takers' monthly report data, is decidedly greatest in the two southernmost tiers of counties. It is moderately large in the lower and upper counties bordering the Mississippi and along the Illinois and Embarrass rivers.

Red foxes are found in all Illinois counties, while gray foxes are found in comparatively few, fig. 13. About 30 years ago, Forbes (1912) reported that foxes were found in 40 of the 102 counties of the state. A recent examination of game wardens' letters on which Forbes based his statements reveals that the wardens in more than half the counties of the state reported gray foxes, presumably the less widely distributed of the two species. The questions to which the wardens replied had been so worded that they may have been uncertain whether the information desired relative to foxes referred specifically to their own counties or to the state as a whole. Most of them answered specifically for their respective counties. Some of the wardens of that day apparently were not aware that foxes occurred in the counties under their charge, and others perhaps did not know a gray fox from a red fox. Therefore, the accompanying map, fig. 13, based in part on the reports from these wardens, may not give a highly accurate picture of the occurrence of gray foxes in Illinois in 1912.

Gray foxes were reported by wardens chiefly in the northern three tiers of counties, along the Illinois River, and along the Mississippi and Ohio rivers in the southern part of the state. Topographic features of these regions are favorable to gray foxes, and present records show that these animals occur there today; despite local inaccuracies, the general distribution pattern as derived by Forbes from the wardens' reports was probably approximately correct for 1912.

When timber was more widely distributed in Illinois than at present, the distribution of gray foxes in the state was possibly greater. That condition may account for the reported occurrence of gray foxes in central Illinois in 1912.

Dates more recent than 1912 on the map, fig. 13, refer to collecting or fur-

takers' records. The fur-takers' records are believed to be highly accurate. They have been checked as to locality in which each reporting fur-taker operated. The determination in each case has every likelihood of being correct; the fact that each of these fur-takers, without being required by law to state whether he had caught a red fox or a gray fox, specified which kind he had caught indicates that he knew the difference.

It is of interest to note that those counties that bear recent date records for gray foxes, fig. 13, and are therefore in gray fox range, show the highest concentration of foxes, both species combined, fig. 12. The gray fox population is largely responsible for the greater fox catches in these counties.

Trappers, Catch and Income.—Index figures for per cent of fur-takers catching foxes (red and gray) fluctuate with such regularity as to suggest cycles,

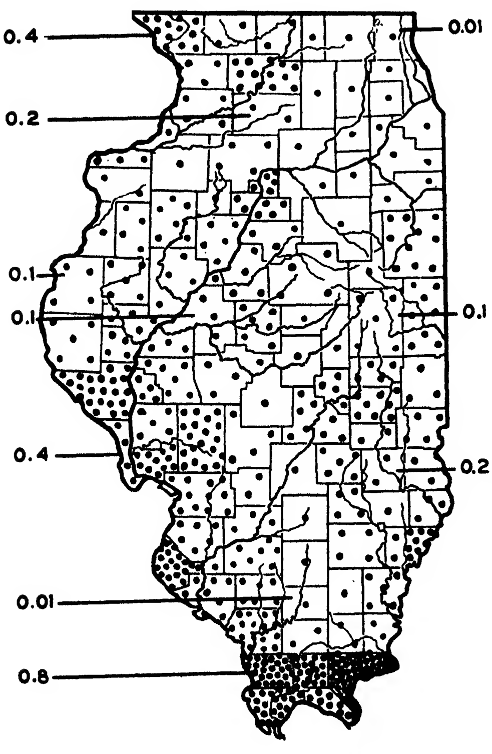


Fig. 12.—Distribution of foxes in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40. Data for these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

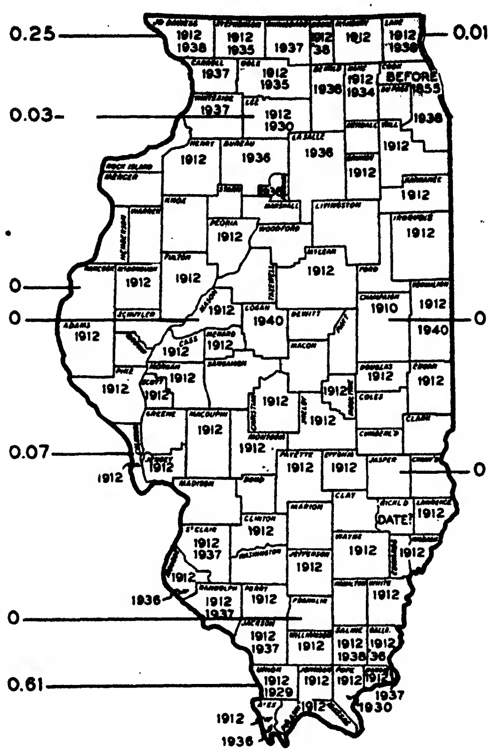


Fig. 13.—Recent specific records of gray fox occurrence in Illinois. Dates show counties in which gray foxes were reported for the year indicated. Figures in the margins show catch per square mile as revealed by the Brown & Yeager report for the 1938-39 and 1939-40 seasons.

table 7. They rise from 14 for the 1934-35 season to 16 during the 1936-37 and 1937-38 seasons, and then drop to 14 during the 1938-39 season, only to rise to 18 in 1940-41.

The distance between peaks and troughs may not be measured because of lack of data for the three seasons following 1930-31.

The index figures for the average catch per effective fur-taker tend to run counter to the index figures for the per cent of

fur-takers catching foxes, in general being high when the latter are low; but they show the same periodicity, nevertheless. This counter trend is of considerable interest because it is marked for foxes and because it is also characteristic of coons. Both animals are less common than some of the other furbearing species, and it may be that rises in numbers of foxes in Illinois, possibly also coons, are more quickly reflected in index figures showing per cent of fur-takers catching the animal than in index figures showing the average catch

Table 7.—Weighted per cent of Illinois fur-takers catching foxes (red and gray), and weighted average catch of foxes per effective fur-taker; data obtained from fur-takers' monthly reports, and weighting done on the basis of the relative size of the counties represented.

Season	Weighted Per Cent of Fur-Takers Catching Foxes	Weighted Average Catch of Foxes Per Effective Fur-Taker
1929–30..	12	2.1
1930–31..	11	2.3
1934–35..	14	2.5
1935–36..	15	2.1
1936–37..	16	2.2
1937–38..	16	2.9
1938–39..	14	2.9
1939–40..	15	2.3
1940–41..	18	2.5
1941–42..	16	2.4

per effective fur-taker; *i.e.*, when foxes become common, many persons succeed in catching one fox each, whether they try or not, but their average is low because they do not repeat their success.

Index figures showing per cent of fur-takers catching foxes are 0.0 to 2.0 points higher for 1938-39 and 1939-40, respectively, than corresponding figures calculated from data provided by the oral survey. Average catch indices for effective fur-takers are 1.3 and 1.1 points lower than the per fur-taker averages calculated from Brown's data for the 1938-39 and 1939-40 seasons, respectively.

If these differences between oral and written data held previous to the 1938-39 season, then we may assume that during the seasons of this study, ending with 1939-40, about 3,200 fur-takers caught foxes annually, totaling approximately 11,400 foxes.

These figures amount to 1 fox trapper or hunter to about 18 square miles, or roughly 31 per county; and about 1 fox caught to each 5 square miles, or about 112 per county.

Numbers of Red Foxes Caught.—It is not possible to estimate with great accuracy the annual income from foxes

Table 8.—Estimated numbers and values of red foxes caught in Illinois, by two-season periods; estimates based on fur-takers' monthly reports.

Seasons	Estimated Number	Estimated Value
1929–30 and 1930–31	16,600	$107,000
1934–35 and 1935–36	8,800	27,000
1936–37 and 1937–38	17,000	52,000
1938–39 and 1939–40	17,400	50,000
Average per season	7,500	30,000

Table 9.—Estimated numbers and values of gray foxes caught in Illinois, by two-season periods; estimates based on fur-takers' monthly reports.

Seasons	Estimated Number	Estimated Value
1929–30 and 1930–31	8,300	$35,000
1934–35 and 1935–36	4,400	4,400
1936–37 and 1937–38	8,500	12,900
1938–39 and 1939–40	9,200	16,200
Average per season	3,800	8,600

even by two-season periods earlier than 1938 because of the difference in value between pelts of gray foxes and red foxes and because the ratios of reds to grays change considerably from period to period.

According to the oral survey, 2.5 red foxes were caught for each gray fox during the 1938-39 season and only 1.4 reds to every gray during the next season. The ratio for the two seasons averaged about 2 reds to each gray. If this ratio held before the 1938-39 season, we may assume that the numbers of reds caught during the period of this study were about as shown in table 8. We can be certain that the

Fig. 14.—An immature red fox taken in Champaign County, 1942.

red fox catch outnumbered the gray fox catch by substantial numbers. Leopold (1931) indicates that, when he made a game survey of Illinois, many times more red foxes than gray were caught in Jo Daviess, Stephenson and Carroll counties, where gray foxes are relatively common. It is estimated that during the period of this study ending in 1939-40 about 7,500 red foxes were caught annually in Illinois, table 8, roughly 75 per county, or an average of about 1 to each 7 or 8 square miles. An immature red fox is pictured in fig. 14.

Income From Red Foxes.—The average annual income from red foxes for the period of this study ending in 1939-40 is estimated to have been about $30,000, table 8; or about 50 cents per square mile; roughly, $300 per county. This annual income from red foxes is estimated to have averaged slightly more than $1 per Illinois fur-taker.

Numbers of Gray Foxes Caught.—The average annual catch of gray foxes for the period of this study ending with 1939-40 is estimated to have been about 3,800, table 9; or 1 to each 14 or 15 square miles. Most of the catch was concentrated in the hilly and timbered areas along the Mississippi and Ohio rivers. Gray foxes are now present in relatively few counties in Illinois; they were once more widely reported.

Income From Gray Foxes.—The average annual income from gray foxes for the period of this study ending with 1939-40 is estimated to have been $8,600, table 9; or 15 cents per square mile.

LONG-TAILED WEASEL

Distribution.—The average annual catch of weasels per Illinois fur-taker, according to fur-takers' monthly reports, is greatest in an area extending from the northeastern corner of the state southwestward toward Knox County, fig. 15. Zones of moderate catches lie on either side of

Table 10.—Weighted per cent of Illinois fur-takers catching long-tailed weasels, and weighted average catch of these weasels per effective fur-taker; data obtained from fur-takers' monthly reports, and weighting done on the basis of the relative size of the counties.

Season	Weighted Per Cent of Fur-Takers Catching Weasels	Weighted Average Catch of Weasels Per Effective Fur-Taker
1929–30...	7	1.7
1930–31...	7	1.8
1934–35...	17	1.8
1935–36...	13	1.6
1936–37...	17	2.2
1937–38...	12	1.5
1938–39...	12	1.6
1939–40...	15	1.9
1940–41...	19	1.9
1941–42...	9	1.3

this strip of counties, one penetrating directly southward into the middle of the state. Another zone of moderately large

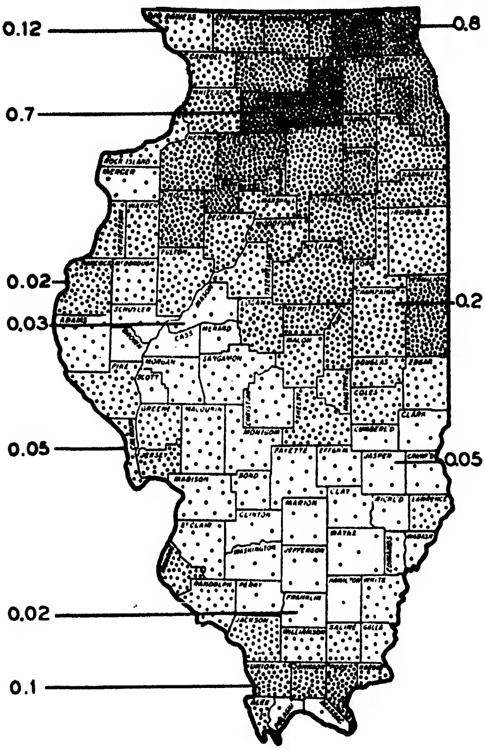


Fig. 15.—Distribution of long-tailed weasels in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40. Data from these eight seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally. The numbers in the margins represent for each county indicated the average catch per square mile as revealed by Brown's survey for the 1938-39 and 1939-40 seasons. In general, a close correlation exists between the two sets of data, despite the fact that one is for eight seasons and the other for two.

catches occurs in and near the second tier of counties in southern Illinois.

A zone of very small catches lies in the south central counties.

Winter white weasels have been reported 23 times from the northernmost tier of counties by trappers who filled out the fur-takers' monthly reports examined in the course of this study. From the second tier of counties they have been reported only 14 times, and from counties south of the second tier only 4 times.

Trappers, Catch and Income.—Index figures for per cent of fur-takers catching long-tailed weasels declined slowly following the 1934-35 season from 17 in that season and, after a high of 19 for the 1940-41 season, reaching 9 in 1941-42, table 10. The figure for the 1941-42 season is so little above the 7 for the 1929-30 and 1930-31 seasons as to indicate that the long-time population trend is probably not upward. Index figures for average catch per effective fur-taker follow a pattern somewhat similar to that of the figures for the per cent of fur-takers catching weasels. Irregularities in the trend pattern appear due to and correlated with irregularities in reporting, with the possible exception of the figure for the 1940-41 season, which may have marked a real peak.

Figures obtained from the written monthly reports for the per cent of fur-takers catching long-tailed weasels are 3 to 4 points higher than those obtained from data assembled by the oral survey. Both sets of data show an increase for the 1939-40 season over the preceding season.

The index figures for average catch per effective fur-taker for 1938-39 and 1939-40 are 1.6 points and 1.0 point lower, respectively, than fur-taker catch figures obtained from data assembled in the course of the oral survey.

If these differences and similarities held during previous years of the study, then we may assume that on an average about 2,200 fur-takers caught about 6,000 long-tailed weasels annually, worth $1,500. Averages are for the seasons of this study ending with 1939-40.

These figures amount to almost 22 weasel trappers per county, or 1 to each 26 square miles; 1 long-tailed weasel to each 9 or 10 square miles, or about 59 per county, averaging somewhat less than $15 worth per county.

LEAST WEASEL

Although frequently caught, skinned and sold by inexperienced young trappers, least weasels are unimportant in the Illinois fur trade, being too small to interest furriers. They are commonly reported from Lake and McHenry counties, and,

in 1939, the writer collected one of this very small species dead on the highway as far south as Henkel in the southeast corner of Lee County.

BADGER

Distribution. — Until badgers were given year-around protection, these animals were commonly caught by trappers in a group of counties in northern Illinois, most of them in the five counties in the northwestern part of the state that are heavily stippled on the distribution map, fig. 16. The number was usually between 5 and 15 annually in each of these counties. Moderate numbers were caught in those counties that are lightly stippled on the map, all of them close to the heavily stippled counties. The code in force July 1, 1937, placed badgers on the protected list with no open season. Since that date the legal killing of badgers has been limited to those animals destroying property.

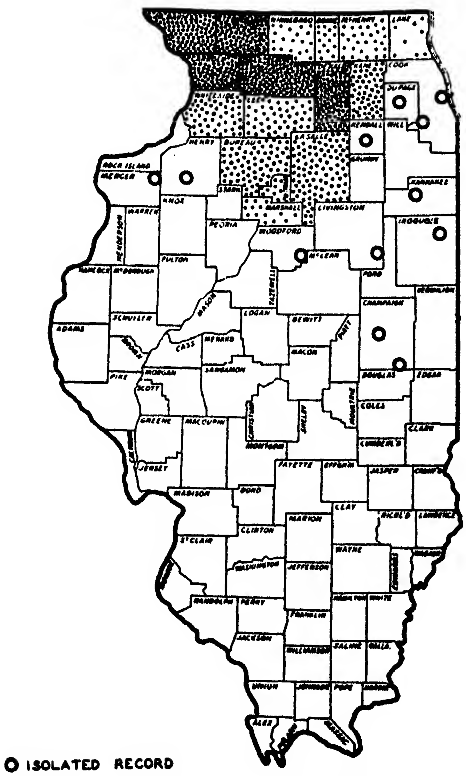


Fig. 16.—Distribution of badgers in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1936-37. Data from these seasons of monthly reports have been transferred to the map in such a way that the county having the largest average catch per fur-taker has the greatest density of dots; other counties are dotted proportionally.

Circles show localities from which badgers have been reported occasionally, fig. 16. Most of these badgers were carried there as caged animals and finally liberated; others were pioneering far away from the main body of their present range. They do not occur regularly in the counties in which the circles are shown.

Kennicott (1855) stated that badgers were formerly common in Cook County and were, when he wrote, still common farther south. Later he added (1859) that in Illinois badgers were once numerous at least as far south as the middle of the state and were seen 30 years before near the Kaskaskia River. At that time they still existed in De Kalb County, according to him.

Brayton (1882) mentioned a badger taken in Kankakee County in 1857. Wood (1910) wrote that "reliable persons" reported they had seen a badger that had been killed a few miles north of Urbana in 1908.

Cory (1912) believed that, at the time he wrote, badgers still occurred "occasionally in the northern two-thirds of Illinois." Gregory (1936) recorded specimens from Du Page and Lake counties. Necker & Hatfield (1941) recorded an additional specimen from Lake County and one from near Chicago.

Joe B. Davidson, biologist of the U. S. Soil Conservation Service, reported a badger killed near Cambridge in Henry County in 1940 and added that badgers were becoming more common than they had been 4 years previously. One was caught in Mercer County, not far west of Cambridge, in 1929, according to a note by a trapper.

A badger caught in the southeast corner of Woodford County a few summers ago was taken to the zoological park in Bloomington, only to escape within a few days.

Koestner (1941*a*) reported a badger from Kankakee County in 1939; the skull of this animal is in his collection. During 1942, residents of Martinton, Iroquois County, reported badgers fairly common there. Trappers reported to the writer that badgers were killed each year since

1935 in Du Page, Kendall and Livingston counties. The writer saw a very old male with badly worn teeth caught in the southern part of Champaign County about 1930.

Extensive collecting and observation by biologists and game specialists of the Illinois Natural History Survey and by naturalists of the University of Illinois have shown that badgers are at present extremely rare as far south as Champaign County. For example, Koestner (1941*b*) made no mention of having found any badgers while collecting in Ford County in 1940. In making his fur survey of Champaign County, Brown found no evidence to indicate that badgers had been killed in this county in 1938-39 or 1939-40.

Catch.—During the years for which we have data when badger trapping was legal, probably not over 150 and rarely over 50 badgers were caught annually in Illinois; the total number was not an appreciable percentage of the total catch of furbearers in the state. Their pelts being worth only about 75 cents each, badgers contributed little to the Illinois fur income.

Data are not sufficient to indicate much about changing numbers, but persons in the Illinois badger range commonly report that badgers are increasing. There is some indication that the range is being extended, counties around the outer margin of the range having shown a catch only in recent years.

BOBCAT

Once undoubtedly present throughout Illinois, the bobcat disappeared rapidly as the country was settled, partly because it requires extensive stands of unpastured timber and partly because it is exciting and easily treed game. Generally, it disappeared most rapidly in the northeastern and mideastern portions of the state. Kennicott (1855) reported it present sometime previous to 1855 in Cook County. A warden in Jo Daviess County reported to S. A. Forbes by letter that short-tailed wildcats disappeared from that county about 1850. Wood (1910) reported that early settlers declared wildcats were found in Champaign County between 1835 and 1840. He obtained the skull of one of a pair killed in Alexander County in 1908.

Cory (1912) wrote, "It has lately been reported from Jo Daviess Co., Illinois, and Kennicott records it from Cook Co., although none has been observed in this vicinity for many years. There is a specimen in the Northwestern University collection at Evanston, taken near Rock Island, Illinois, some years ago. In extreme southern Illinois I have trustworthy information that it still occurs in more or less numbers in Galletin, Pope, Alexander, Jackson and Randolph Counties. Mr. J. G. Baker of Golconda, Pope Co., informs me that two Wild Cats were killed in that vicinity in the winter of 1907."

Forbes (1912), after making a statewide checkup on the condition of wildlife, stated that "lynxes and wildcats" were reported in 14 counties, 7 of them in extreme southern Illinois. Examination of the wardens' reports on which Forbes based his statement shows bobcats in 12

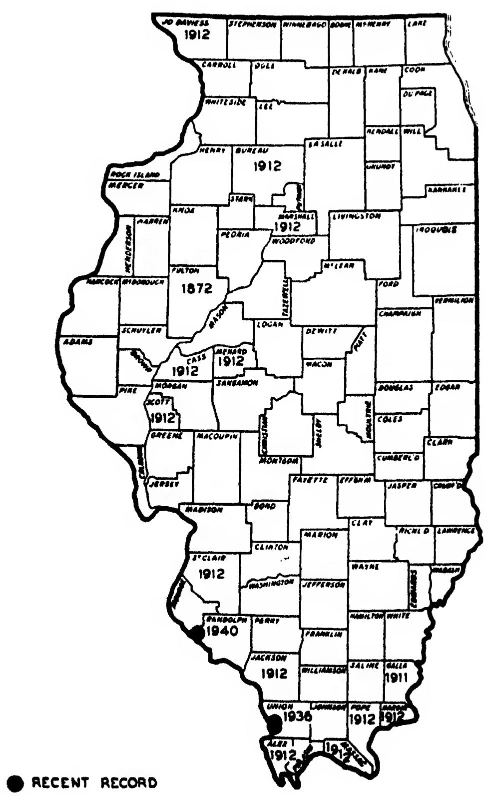


Fig. 17.—Recent specific records of bobcat in Illinois. Dates show counties in which bobcats were reported for the year indicated.

counties, 7 of them bordering the Ohio or Mississippi rivers and 5 bordering the Illinois or Sangamon rivers, fig. 17.

Two bobcats were killed in Union County in 1936, and one specimen is mounted in a restaurant at Ware, fig. 18. One large bobcat was shot in a swamp near Miller City, Alexander County, in November, 1942, one was killed near Murphysboro in December, 1942, and three additional bobcats were killed, presumably near Murphysboro, late in 1942 or early in 1943 (Anonymous 1943). An unverified recent record for Randolph County is reported by Necker & Hatfield (1941). Earnest and excited hunters almost regularly report bobcats from various parts of the state, usually from the heavily wooded southern counties. The U. S. Forest Service (1937, 1938) fails to report bobcats within its Illinois holdings, the Shawnee National Forest, indicating that, if these animals are present, they are extremely rare. They are not now protected by law.

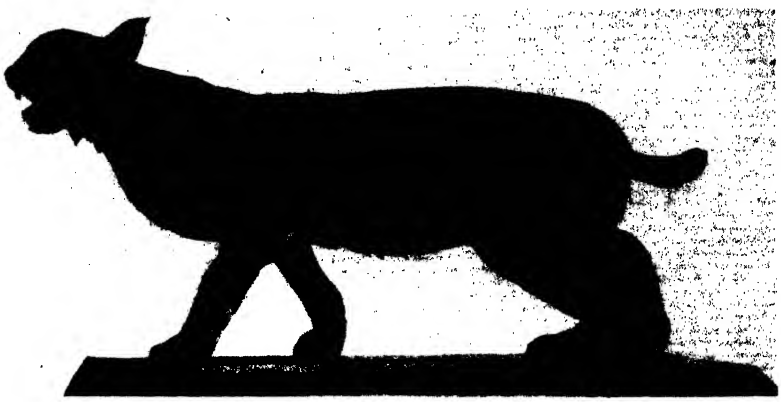


Fig. 18.—Bobcat or bay lynx, *Lynx rufus*, caught at Ware, Union County, Illinois, 1936. Its weight was 21 pounds.

DOMESTIC CAT

In 5 recent years, 104 domestic cats were reported caught by the 8,862 furtakers making reports in those years. It is probable that the 121,566 trappers estimated to have operated during those years caught about 1,300 or more cats, or about 260 annually. Worth only about 10 cents apiece, the pelts add little to the fur income of the state.

OTTER

Otters have long been so scarce in Illinois that they have not figured largely in the state's fur trade for many years. They were subject to an open season throughout Illinois until the end of the 1928-29 fur season. In the game code of 1929, they were given complete protection until Nov. 15, 1933; before that date arrived, the period of complete protection had been extended indefinitely.

At one time distributed along all of the Illinois rivers, and, according to Kennicott (1855), not uncommon in Cook County about 1855, otters were by the winter of 1907-08 commonly reported only from southern Illinois; several were taken in the cypress swamps of Alexander County during that winter, according to Wood (1910). A few were still present in some of the counties farther north, bordering or near the Mississippi and Illinois rivers, fig. 19, according to Forbes (1912) who had requested Game Commissioner John Wheeler to obtain information about their distribution. Although the Commissioner so worded his letter to game wardens in each county that they might conclude that Forbes wished to know if otters were present anywhere in Illinois, most of them answered specifi-

cally for their own counties and most of their answers showed close grouping near the Ohio, Wabash and Mississippi rivers in southern Illinois, where Forbes concluded otters were still common.

Since 1912, the record is one of rapidly receding range and, at least until the last half dozen years, of continuous failure to check their decline, even after legal protection was extended them throughout the year.

According to an unpublished manuscript by Leopold (1929), an otter was taken near Meredosia, on the Illinois River, in 1926, and a few otters were present in Union County in 1929. Bennitt & Nagel (1937) recorded two otters in 1934 from the Mississippi River in Lincoln County, Mo., opposite Calhoun County, Ill., and

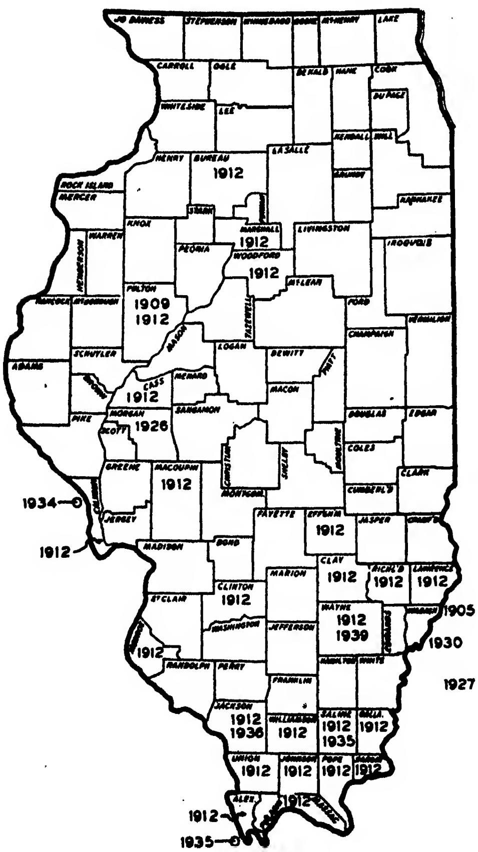


Fig. 19.—Recent specific records of otter in Illinois. Dates show counties in which otters were reported for the year indicated. Circles show nearby Missouri records. Dates east of Illinois indicate nearby otter records in Indiana.

others in 1935 in Missouri opposite Alexander County, Ill., fig. 19. Scott (1937) did not report any recent records on the Mississippi River in Iowa.

During the spring of 1939 an otter was accidentally caught in a fish net in the Little Wabash River in Wayne County by Harold Riggs of Goldengate, Ill. (Anonymous 1939).

According to a letter dated Jan. 26, 1939, from Galen W. Pike of the U. S. Forest Service at Harrisburg, Ill., several otters were reported in Saline County, and an otter was seen in 1935 by William E. Bates at Big Lake, 2 miles northeast of Shawneetown, in Gallatin County. Residents of Union and Alexander counties still report otters occasionally, and it is hoped that the Shawnee National Forest in these southern counties, rising public interest and extended soil conservation practices will enable Illinois otters to survive and perhaps increase and spread. In recent estimates of the numbers of furbearing animals on the National Forests (U. S. Forest Service 1937, 1938), otters are not listed as being present in Illinois, probably because they are difficult to locate or extremely rare. Lyon (1936) found the general pattern of otter decline in Indiana similar to that in Illinois. Most of the recent dates for otter records in Indiana are in those counties bordering the Ohio and White rivers near Illinois; some of these dates are shown in fig. 19.

Bonnell (1941) reported 20 otters present in the Shawnee National Forest in southern Illinois in 1940. Some naturalists and rangers there are inclined to feel that this estimate is too large.

COYOTE

Wolves are often claimed to occur in Illinois; this common name is generally applied to coyotes, known also as brush wolves or prairie wolves, and sometimes to wild dogs. We have no reliable evidence that timber wolves are present within the boundaries of Illinois or that they have been during the present century, although Wood (1910) states: "During the years 1883 to 1905 inclusive, bounties were paid on 159 wolves killed in Champaign county. Wolves have been reported within the county since that date, and it is not at all unlikely that a few still exist

in the heavy timber along the Sangamon River and the Vermilion."

Among about 1,600 fur-takers who reported during the 1939-40 season, only 2 stated that they had caught "wolves," which were probably coyotes. If the same ratio holds for the 25,000 or more trappers who did not report, we may assume that less than 40 coyotes were caught.

Coyotes are not protected by law at any time of year, and a number of them are annually turned in for bounty at a time when their pelts are not salable. Most are turned in for bounty in the northern half of Illinois; very few are taken in the southern quarter, fig. 20. Two skulls, turned in for bounty as those of "wolves,"

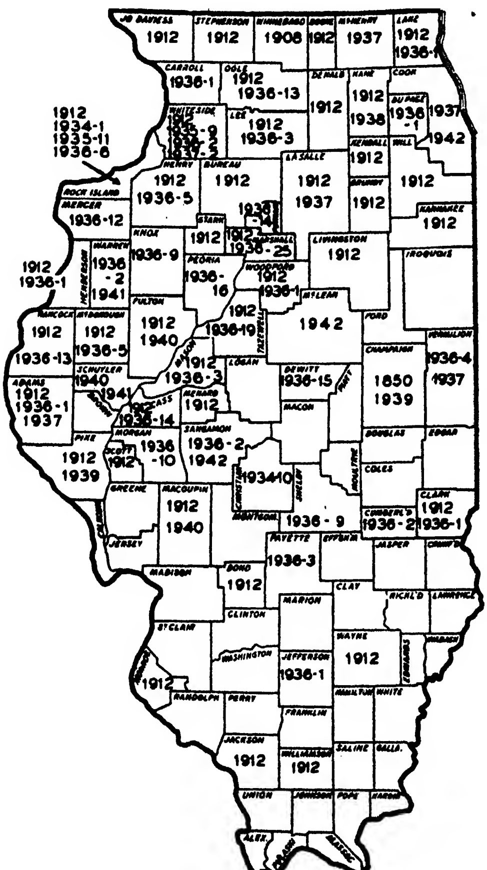


Fig. 20.—Recent specific records for Illinois of coyote and of dog misidentified as coyote or "wolf." Dates show counties in which these animals were reported for the year indicated. The numerals following some of the dates indicate the number of animals reported for those years.

one in Schuyler County, figs. 21 and 23, and one in Warren County, figs. 22 and 23, and now in the collection of E. J. Koestner, formerly of the University of Illinois, were submitted to Dr. George G. Goodwin of the American Museum of Natural History, New York, who determined them as coyotes with possibly a faint trace of dog blood.

The Illinois Natural History Survey collection contains two skulls from McLean County and one from Sangamon County, collected in 1942 and determined as coyotes by E. A. Goldman of the U. S. Fish and Wildlife Service. A third, from the Cook County Forest Preserve District in 1942, has been determined as a coyote by the writer. Fig. 24 pictures the head of this animal.

A skull in the American Museum of Natural History, collected in Macoupin County in 1940, was determined as a coyote by Dr. Goodwin.

A rough idea of the distribution of coyotes in Illinois may be gained from reports of their presence in 1912, from the number reported turned in for bounty to county clerks and from reports in newspapers; however, some of the animals reported in newspapers as coyotes are wild dogs. Because dogs that run wild, as well as coyotes, are commonly reported by hunters, trappers, county clerks and reporters as "wolves," it is impossible to plot the distribution of these animals separately. Fig. 20 shows the distribution of so-called "wolves," coyotes and wild dogs reported as coyotes.

Some miscellaneous records are presented below.

Wood (1910) quotes early settlers as declaring coyotes were common in Champaign County about 1850 and seen in this county 10 years later.

During the 1937-38 season, trappers reported catching "wolves" at Payson, Adams County; Serena, La Salle County; and Bensenville, Cook County.

In about 1938, three hunters from Granville and Spring Valley captured two old "wolves" and seven cubs, according to the *Illinois Sportsman* for February, 1940; the location was probably Putnam County.

During February, 1937, "wolves" were reported cornered in a gravel pit near Crystal Lake, McHenry County, accord-

Fig. 21.—Skull of animal shot in Schuyler County, Illinois, January, 1941. Determined by Dr. George G. Goodwin as coyote with possibly a trace of dog.

Fig. 22.—Skull of animal shot in Warren County, Illinois, January, 1941. Determined by Goodwin as coyote with possibly a trace of dog.

ing to the Chicago *Daily Tribune* for Feb. 8, 1937.

About Jan. 7, 1937, the Danville *Commercial-News* carried a story about a "wolf" having been shot near Potomac, Vermilion County.

"Wolf" drives were planned or held April 5 and March 19, 1938, near Clinton, De Witt County, according to the Decatur *Herald-Review* for March 19, 1938.

A pack of "wolves" was found near Broadlands, Champaign County, about Feb. 16, 1939, according to the Arcola *Record-Herald* of that date. Two were shot on different days; one weighed 24 and the other 46 pounds, according to the newspaper account. The 24-pound individual was identified by the writer as a reddish chow dog, which in death, at least, carried its tail straight rather than curled in usual chow fashion.

According to the Chicago *Daily Tribune* of Dec. 28, 1938, a "wolf" weighing 33 pounds was shot the day before near Sugar Grove, Kane County.

In about 1938, wild dogs were common in rough country 4 miles north of Harrisburg, Saline County, according to R. E. Favreau, at one time employed by the Illinois Natural History Survey.

According to the *Pike County Democrat*, a "wolf" was shot near Summer Hill about Oct. 18, 1939, and another was seen. The county board had recently passed a resolution placing a bounty on wolves. One had been reported killed near Pittsfield a few weeks before the resolution was passed.

According to the Champaign-Urbana *News-Gazette*, Feb. 28, 1939, at least one "wolf" had recently been reported near Mahomet.

Fig. 23.—Another view of skulls of animals pictured in figs. 21 and 22.

About Dec. 6, 1936, a "wolf" and fox hunt was planned for near Morrison, Whiteside County. This yielded several gray foxes and one red fox but no coyote.

Coyotes were common around West-field, Clark County, in December, 1936, according to the Charleston *Daily Courier*, and some were shot. A man said to be familiar with coyotes in the western part of the United States thought that some of the animals shot were too heavy to be coyotes and claimed they were timber wolves.

In June, 1939, an animal killed in a roundup near Decatur was exhibited as a "wolf" at that city and the head was finally brought to the Illinois Natural History Survey; E. A. Goldman of the U. S. Biological Survey determined the skull as that of a dog.

Recently, Bonnell (1941) reported 10 "Wolves and Coyotes" counted in one unit of the Shawnee National Forest in southern Illinois.

These miscellaneous records do not by any means come near to exhausting the list of references on the subject. This much may be concluded from them: that coyotes, wolflike dogs or occasional coyote-dog crosses are most commonly observed or captured in those counties lying along the Des Plaines River, the Illinois River and the Mississippi River in the northern part of the state.

Fig. 24.—Head of coyote, *Canis latrans*, from Cook County Forest Preserve. Note length of tusks, shape of furred ears and streamlined skull.

MARTEN

Martens have by pure accident been recorded recently from Illinois (U. S. Forest Service 1937). The Illinois game code for some of the years previous to 1941 listed martens among the protected fur-bearing animals, and various journals copying Illinois fur laws assumed martens to be present in the state. The marten has probably been extinct in Illinois beyond the memory of men now living.

SPOTTED SKUNK

Cory (1912) lists and maps spotted skunks or civets as present in southern Illinois, basing his judgment partly on a statement by another writer that they

were reported to be fairly common at Golconda. No reliable evidence has turned up since to show that spotted skunks are present anywhere in this state, although the F. C. Taylor Fur Company of St. Louis, Mo., lists prices of Illinois civets.

BEAVER

Although beavers once occurred throughout Illinois, Wood (1910) wrote that they seemed to have been practically exterminated in and around Champaign County before the first permanent settlers came. Forbes (1912) wrote that beavers were reported in four Ohio River counties. They later became extinct in Illinois, but have since been reintroduced, fig. 25.

The first shipment of reintroduced beavers was released Nov. 2, 1935; 10 in Hunting Branch, a tributary of Bay Creek, 6 miles southeast of Stonefort, and 9 in Grand Pierre Creek, 2 miles southeast of Herod, both locations in Pope County. Soon afterwards, those in Hunting Branch moved downstream into Bay Creek, where their signs were observed over 1½ miles south of the place at which they were released. A year later some of these were found in the locality of the town of Robbs, which is about 8 miles from the spot of release. Those liberated in Grand Pierre Creek remained in the general locality, where they built one dam and where their cuttings and other signs are now common.

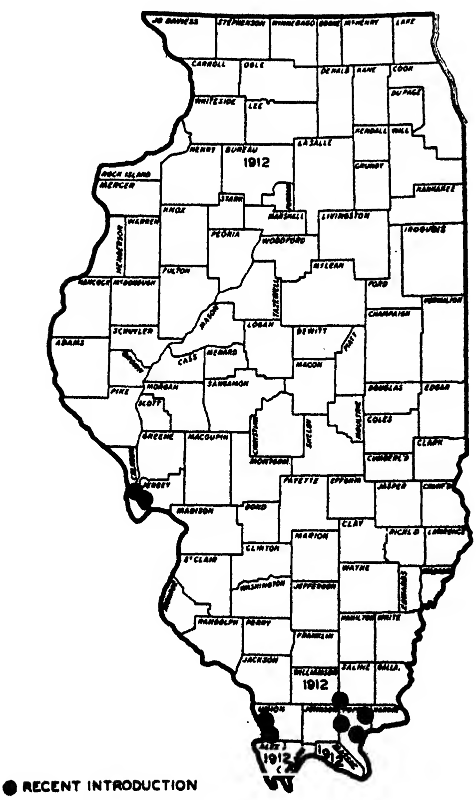


Fig. 25.—Records of beaver occurrence in Illinois. Dates show counties from which they were last recorded. Large dots indicate recent introductions of beavers into Illinois.

During the fall of 1938, three beaver dams were reported in Lusk Creek about 5 miles up from its mouth at the Ohio River. In order to find their way here, the beavers probably migrated down Bay Creek to the Ohio River, then up the Ohio to Lusk Creek, and finally up Lusk Creek 5 miles to the new location. It is not likely that they traveled across country between Bay Creek and Lusk Creek.

On March 1, 1936, four beavers were received from Wisconsin. One died enroute and a second, weakened or injured by the trip, died shortly after it was set free. The skull of this second animal is in the Illinois Natural History Survey collection. The live animals were turned loose on the property of the East St. Louis Hunting Club near Reynoldsville, in Union County. No beaver or beaver signs were reported there until late in 1938, when a dam was found across Clear Creek Drainage Ditch, west of the hunting club. In 1940, there was a large used beaver burrow near this club and a lodge near Reynoldsville. A Union County beaver lodge is shown in fig. 29 of the Brown & Yeager report.

A small colony was recently reported present at a lake owned by L. E. Groppel, Rosedale Township, Jersey County; beavers were introduced there by the State Department of Conservation in August, 1936 (Thatcher 1937).

The last consignment of beavers consisted of three received during October, 1938. These animals were released in La Rue Swamp, 2 miles north of Wolf Lake in Union County, the most favorable of the sites where beavers have been released.

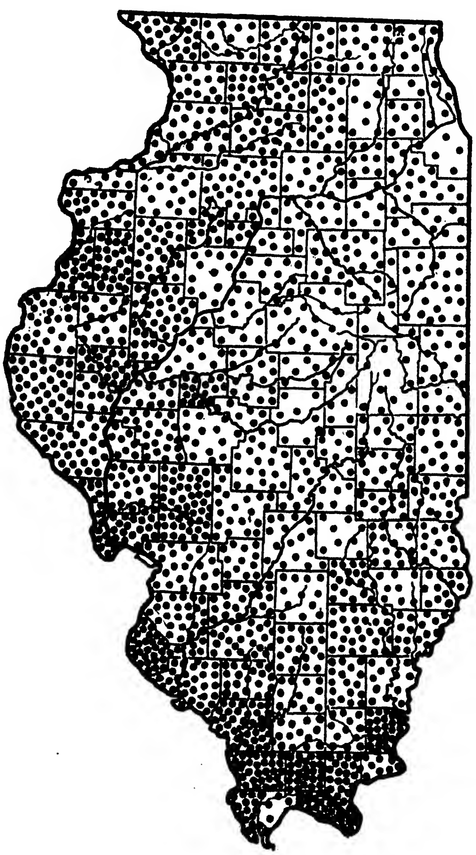
The beavers (a total of 24 in addition

to the Groppel Lake colony) released in southern Illinois have firmly entrenched themselves there. The total estimated population in the Shawnee National Forest in 1939 was 48. They numbered only 19 in December, 1935, and 25 in 1937, according to U. S. National Forest estimates of furbearing animals in national forests. Bonnell (1941) reported "about 70" beavers present in the Shawnee National Forest by 1940. They are now widely scattered and should continue to increase.

TOTAL ANNUAL CATCH

Probably about 958,000 individuals of our eight common furbearers are caught annually in Illinois, or 17 per square mile, amounting roughly to 9,400 per county. Individual fur-takers average about 37 animals each per year.

Most of the predatory and omnivorous species are caught in the southern, southwestern and western counties, fig. 26, where extensive woods or bushy areas make favorable habitats for them. Most of the muskrats, the state's single legally caught herbivorous furbearer, are taken in the northern counties, fig. 4.



Distribution of Predator catch.

Fig. 26.—Distribution of predatory species in Illinois as indicated by fur-takers' monthly reports for the seasons of 1929-30, 1930-31 and 1934-35 through 1939-40.

Table 11.—Estimated average annual number of common furbearers caught in Illinois beginning with the 1929-30 season and ending with the 1939-40 season (1931-32, 1932-33 and 1933-34 omitted because data for these seasons were not available).

Furbearer	Average Annual Catch
Muskrat	653,000
Possum	141,000
Skunk	58,000
Mink	56,000
Coon	32,000
Red fox	8,000
Long-tailed weasel	6,000
Gray fox	4,000
Total	958,000

The total number of furbearers caught, so far as we are able to estimate from data collected, was about as great during the 1938-39 and 1939-40 seasons, covered by the oral survey, as during any other recent 2-year period; although there was a decline in the total numbers of minks and coons caught in the seasons in which Brown made his survey, an unusually large number of muskrats and an increased number of long-tailed weasels and foxes were caught in those seasons.

About 68 per cent of the common furbearers caught in Illinois during the period beginning with the 1929-30 season and ending with the 1939-40 season were muskrats, table 11 (the seasons of 1931-32, 1932-33 and 1933-34 are omitted from the calculations because data for them were not available). Possums held second place, making up about 15 per cent of all furbearers caught.

During some seasons more minks than skunks were caught, but over the period

of this study the total number of skunks caught slightly exceeded the total number of minks. Each species constituted about 6 per cent of the total catch. Coons made up about 3 per cent of the catch.

Red foxes and gray foxes were caught in small numbers, together making up somewhat less than 2 per cent of the catch. Long-tailed weasels made up less than 1 per cent of the catch.

Muskrats were the most numerous furbearers in all but a very few counties, where they were exceeded only by possums. In those counties in which muskrats did not lead, they were in second place for numbers in the catch.

TOTAL ANNUAL INCOME

The average annual income from the Illinois fur catch for the period beginning with the 1929-30 season and ending with the 1939-40 season (seasons of 1931-32, 1932-33 and 1933-34 omitted for reasons explained above) amounted to about $1,067,500, table 12, or about $19 per square mile. These figures are based upon prices for No. 1 medium rather than No. 1 large pelts, table 13. The income was highest during the 1929-30 and 1930-31 seasons, when furbearers were abundant and prices were good, and lowest during the 1934-35 and 1935-36 seasons, when prices were so poor that comparatively few fur-takers cared to operate.

The average total fur income for the 1938-39 and 1939-40 seasons, when the oral survey was made, was about 13 per cent above the average for the 8 years covered by the monthly report study, largely because of price levels and an abundance of muskrats (table 13 of this report and table 4 of the Brown & Yeager report). The oral survey showed a calculated average annual income for the seasons of 1938-39 and 1939-40 of $1,201,830.45 (table 19 of the Brown and Yeager report).

In the 8 years covered by the present study, the average fur-taker sold furs estimated to have an average annual value of about $41. The annual take per county averaged about $10,500.

Muskrats led as income producers year after year, yielding about 47 per cent of the total income over the period of this study. Minks held second place, yielding about 29 per cent of the income over the period. Coons, in third place, produced at least 10 per cent of the income over the study period, but their position

Table 12.—Estimated average annual income from common furbearers caught in Illinois, beginning with the 1929-30 season and ending with the 1939-40 season (1931-32, 1932-33 and 1933-34 omitted because data for these seasons were not available).

FURBEARER	AVERAGE ANNUAL INCOME
Muskrat	$ 500,000
Mink	310,000
Coon	102,000
Skunk	70,000
Possum	39,000
Red fox	36,000
Gray fox	9,000
Long-tailed weasel	1,500
Total	$1,067,500

Table 13.—Average prices estimated to have beeen paid for No. 1 medium* pelts of the eight common furbearers of Illinois.

FURBEARER	1929–30	1930–31	1934–35	1935–36	1936–37	1937–38
Muskrat	$ 1.00	$0.60	$0.70	$0.60	$0.75	$0.60
Mink	7.00	3.50	4.00	3.50	6.50	5.50
Coon	5.50	3.00	2.50	2.50	3.50	3.50
Skunk	2.40	1.20	0.90	0.90	1.00	0.75
Possum	0.40	0.35	0.25	0.25	0.30	0.30
Red Fox	10.00	3.30	3.30	2.50	3.50	2.80
Gray Fox	5.00	3.50	1.00	1.30	1.40	1.40
Weasel	0.25	0.25	0.25	0.25	0.25	0.25

*Prices of No. 1 large pelts are considered too high for calculating income on the average pelt sold.

fell from about 12 per cent during the 1929-30 and 1930-31 seasons to only 6 per cent during the 1938-39 and 1939-40 seasons. Skunks produced about 7 per cent of the income for the period. Possums, although generally caught in greater numbers than skunks, produced less than 4 per cent of the income, because of relatively low pelt value. Red foxes yielded only about 3 per cent of the income, while gray foxes and long-tailed weasels held the lowest positions among the eight commonly caught furbearers, together producing less than 1 per cent of the income.

Muskrats constituted the leading income producer in most counties, but in some southern counties coons or minks took the lead. Although second place went to minks in most counties, coons and skunks took second place in some.

FUTURE POSSIBILITIES

It is important to recognize that the fur crop is in addition to all other crops and values realized from Illinois land and waters. In general, it has persisted not because of any favorable attention paid to it but in spite of what has been done. It comes from areas that are growing woods, pastures and even highly cultivated crops; from streams filled with silt and sludge; from ponds so burned or grazed as to be barely suitable for production of anything at all; from land that has been abused so sadly that because of erosion it will no longer grow cultivated crops but has been given up to produce what it can.

If every gully-scar now cutting deeper into Illinois' fields were planted to protecting vegetation, if every woodlot were properly managed by removal of stock and if every stream were kept reasonably clean of silt, sewage and commercial waste, then populations of furbearers, and game as well, would increase.

If the protecting vegetation were scientifically chosen and if protected woodlots were scientifically cut with reasonable attention to needs of furbearer and game populations, then both populations would increase substantially and supplement the income from soil saved and timber produced.

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